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Unlocking Value in EdTech: An Equity Research Paper on Duolingo Inc. (DUOL)

MAXIMILIAN PLUT

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Abstract

This thesis investigates the target share price of Duolingo, employing the DCF method for intrinsic valuation and trading and transaction comparables for relative valuation. The findings indicate a target share price of $237.8, marking an 8% premium to the share price as of finalization of this report, which leads to a “buy” recommendation. Furthermore, the paper underscores the limitations of traditional valuation methods when applied to high-growth tech firms. It is enriched with a literature review that critiques their applicability in this context, highlighting the need for nuanced valuation methodologies suited to the unique dynamics of high-growth tech companies.

Keywords: DCF valuation, Duolingo, Relative Valuation, Intrinsic Valuation, High-Growth Tech Firms

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INTRODUCTION

"Dear potential investors,

the main thing you need to know is that I plan to dedicate my life to building a future in which, through technology, every person on this planet has access to the best quality of education. And not only that, but a future in which people want to spend their time learning. Duolingo is the platform for building that future, and we are just getting started." – Luis von Ahn, CEO.

This statement is extracted from Duolingo's S-1, the formal registration document filed with the Securities and Exchange Commission (S.E.C.) as part of the company's process to go public. In July 2021, Duolingo unveiled details of its much-anticipated initial public offering (IPO). With a flagship app that stands as the global frontrunner for language learning, Duolingo's trajectory post-IPO unravels as a captivating narrative for equity research.

This thesis aims to determine Duolingo's equity value per share and give a buy, sell, or hold recommendation. Furthermore, it illuminates the limitations inherent in standard valuation techniques applied in this paper (DCF, CCA, and CTA) when applied to high-growth technology firms. The thesis commences with an edtech industry overview and Duolingo's company profile and competitors, followed by a forecast of the financial statements. Duolingo's valuation is then assessed using intrinsic and relative valuation methods. The conclusion offers an investment recommendation, and the final section reviews the limitations of traditional valuation techniques for high-growth tech firms.

1. EDUCATIONAL TECHNOLOGY IN LANGUAGE LEARNING

Educational technology (edtech) uses technology to support learning and teaching. It is becoming more common, with tools like tablets, online platforms, interactive whiteboards, AI, and smartphone apps becoming integral in education (Yahoo Finance, 2022). Technology enhances education by allowing data-driven, AI-enhanced teaching methods and personalized learning experiences. It also encourages engagement through gamification and immersive experiences (Avixa, 2023). The edtech sector is booming, with revenues expected to reach $605.4 billion by 2027, growing at a 15.5% CAGR (Grand View Research, 2022). Technology's role in foreign language education is rapidly advancing, moving beyond traditional classrooms. E-learning tools have become commonplace in language teaching, offering multimedia content and interactive experiences (Sanako, 2021). Edtech benefits teachers by enabling dynamic, engaging classrooms that mix individual and collective learning, integrating real-world contexts, and simplifying content management. It also provides continuous professional development online. For students, it enhances exposure to new languages and cultures, promotes authentic interaction, and supports personalized learning paths for more effective skill acquisition in speaking, listening, reading, and writing. Tech tools also allow for interactive exercises and provide a wealth of resources, including authentic media content, to suit individual needs, thereby improving overall language proficiency (Sanako, 2021).

1.1. EDTECH INDUSTRY TRENDS

Edtech is attracting significant venture capital, with global investments hitting $20.8 billion in 2021, indicating robust growth driven by technological advances, reduced broadband costs, and improved online learning platforms. Despite a dip in public valuations, private edtech firms continue to secure substantial funding due to the sector's adaptability, a trend bolstered by the pandemic (McKinsey, 2022).

To optimize customer lifetime value and tackle high customer acquisition costs, edtech companies are pursuing mergers and acquisitions, aiming for economies of scale. Notable instances include 2U's acquisition of edX for $800 million, the $3 billion merger of Anthology and Blackboard (McKinsey, 2022), and also Duolingo's acquisition of Gunner, a Detroit-based animation studio previously collaborating with Duolingo and clients such as Amazon, Dropbox, Spotify, and Google (Techcrunch, 2023).

Mobile-first preferences and subscription models are reshaping consumer behavior, with a shift towards mobile apps for various services. This trend extends to e-learning, where users expect engaging mobile experiences and are inclined towards subscription-based learning (Duolingo, 2022). The pandemic has accelerated the shift from traditional education to e-learning, a change likely to have enduring effects (Duolingo, 2022).

Advances in generative AI, like large language models, are changing educational technology use, with ChatGPT at the forefront of recent discussions. While AI's disruptive potential is noted, its benefits in personalized learning are equally significant (University of Cambridge, 2023). Edtech is increasingly focusing on student well-being, with AI offering personalized mental health support and fostering skills like empathy and communication, underscoring education's holistic nature (University of Cambridge, 2023). VR and AR technologies are becoming more accessible, likely to enhance educational experiences significantly in 2023 (University of Cambridge, 2023).

1.2. COMPETITIVE LANDSCAPE

Competitors are categorized as direct, offering similar language learning platforms and user experiences as Duolingo; indirect, providing non-gamified, traditional language learning tools; and potential future competitors from outside the language sector, where Duolingo is expanding its presence. This non-exhaustive classification mainly considers significant, internationally recognized market leaders.

1.2.1. Direct Competitors

Babbel, launched in Berlin in 2007 as the first language-learning app, has sold over 10 million subscriptions. The company, with offices in Berlin and New York, offers podcasts, games, videos, and other content via a subscription model. It postponed its IPO on the Frankfurt stock exchange, initially set for September 24, 2021. In 2022, Babbel reported €247 million in revenue. Rosetta Stone, based in Arlington and founded in 1992, offers technology-based language learning in 30 languages and caters to various clients, including government and educational institutions. It went public on April 16, 2009 and reported $182.7 million in 2019 revenues. Busuu, founded in 2008, offers language courses with a freemium model and is used by over 500 businesses and institutions. Chegg acquired it in November 2021 for $436 million after reporting $45 million in revenue. Memrise, a platform specializing in language learning through creative and interactive methods founded in 2010, achieved revenue of $10.9 million in 2022 (Memrise, 2023). Finally, the last direct competitor is Mango Languages, a language learning platform that offers courses in multiple languages and emphasizing cultural awareness founded in 2007. It reported an annual revenue of $14.0 million in 2022 (Mango Languages, 2023).

1.2.2. Indirect Competitors

Pimsleur, an audio-based language-learning company, features the Pimsleur Method, which emphasizes listening and speaking through graduated interval recall for better memory retention. Offering daily 30-minute lessons in various languages immerses learners in conversational practice, maintaining its reputation in the industry (Pimsleur, 2022). Anki, a free, open-source spaced repetition software, assists users in memorizing information, particularly languages, using digital flashcards. It employs spaced repetition to schedule reviews, supporting multimedia and benefiting from a community that provides additional resources (Anki, 2022). HelloTalk and Tandem are apps connecting learners with native speakers for language exchange through text, voice, and video, with tools like translation and correction features, offering an interactive language learning experience in numerous languages (HelloTalk, 2023; Tandem, 2023).

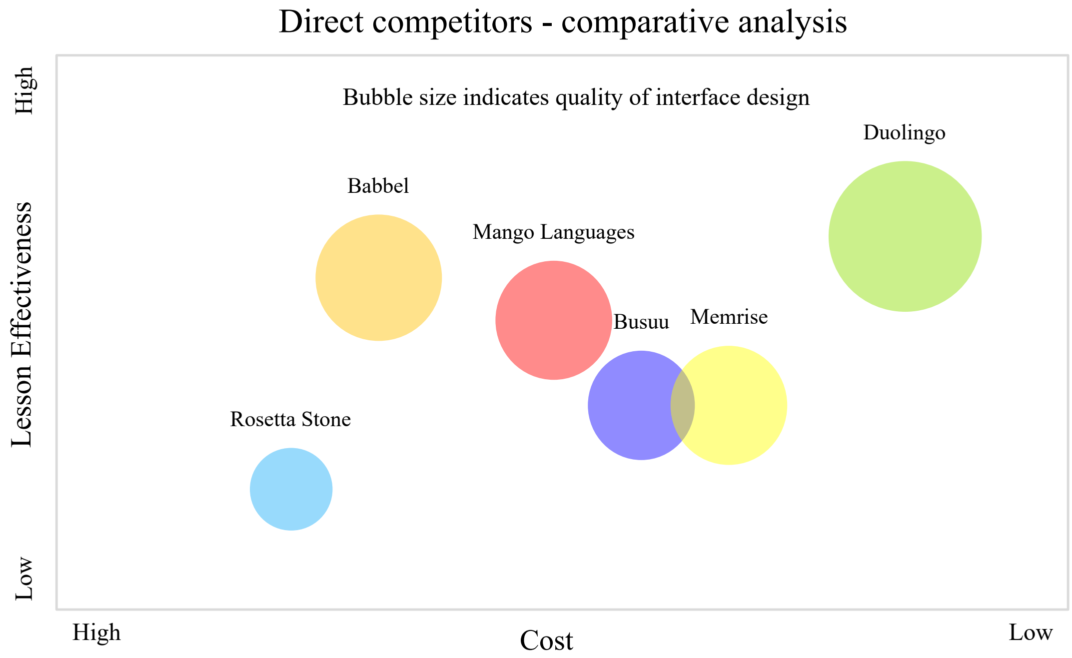
1.2.3. Future Competitors

Duolingo's current expansion into mathematics and music and potential expansion into further subjects would place it in competition with established edtech platforms like Khan Academy, a non-profit that has been offering free, comprehensive educational content since 2008, and Udemy, a vast online learning marketplace founded in 2010 that connects students with instructors worldwide and recently went public, with a 22% revenue increase to $629 million in 2022 (Khan Academy, 2022; Bloomberg, 2021; Udemy, 2023). A third future competitor could be Coursera, an online learning platform that offers courses, degrees, and professional certificates, reported a total revenue of $523.8 million in 2022 (Coursera, 2023).

1.2.4. Comparative Analysis of direct competitors

A comparative analysis of Duolingo and its direct competitors in the digital language learning market is conducted to ascertain Duolingo's competitive positioning in terms of its product offering. This analysis benchmarks three critical dimensions: cost, lesson effectiveness and enjoyment, and interface design and ease of use. To ensure a comprehensive and objective evaluation, each competitor, including Duolingo, is assigned grades on a scale from 1 (representing the lowest performance) to 5 (indicating the highest performance) across these dimensions. The grading methodology hinges on a review of customer feedback from several websites, such as Trustpilot. Figure 1 below offers an overview of the results of the analysis.

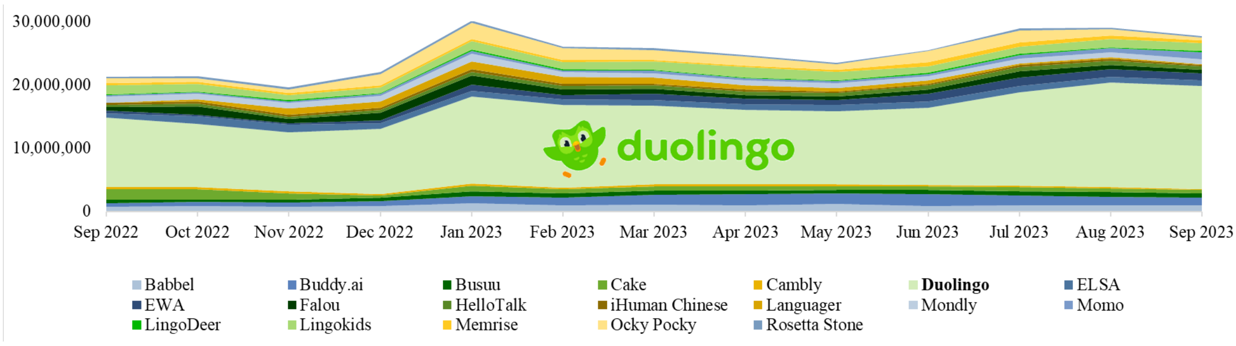
Figure 1: Comparative analysis of Duolingo's direct competitors (created by the author)



Duolingo's language learning software surpasses its competitors across all three evaluated dimensions. The platform's unique approach, where all content is accessible free of charge and the option for an affordable paid membership enhances the learning experience, positions it favorably in terms of cost. Furthermore, Duolingo's robust learning algorithm facilitates rapid progress in language acquisition, underlining its superiority in lesson effectiveness. Additionally, its gamified and intuitive interface not only heightens user engagement but also simplifies learning, making it more enjoyable and user-friendly than its market counterparts. This comprehensive outperformance across key metrics underscores Duolingo's leading position in digital language learning.

To conclude this section, it is important to mention that as a result from its competitive positioning in the market, the Duolingo app was downloaded globally more times than all of its competitor apps combined from September 2022 to September 2023 (see Figure 2 below) (Statista, 2023), which is why Duolingo can be considered a market leader in the edtech language learning industry in terms of the size of its user base and its international reach.

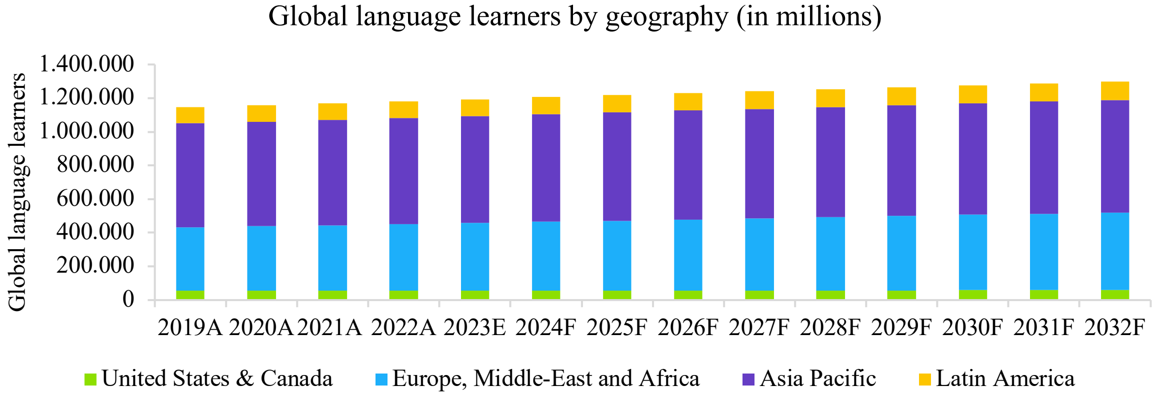
Figure 2: Global language learning app downloads (Source: Statista)



1.3. Estimation of Duolingo's Total Addressable Market

In estimating Duolingo's TAM[1], a conservative approach was adopted, considering the global population actively learning languages and having smartphone access, which is pertinent given Duolingo's expansion into other educational areas. The analysis segmented learners into UCAN, EMEA, APAC, and LATAM[2] regions, highlighting Duolingo's strong presence in North America and Europe and growing markets in Asia and Latin America. The methodology involved forecasting regional populations until 2032 (World Bank, 2023), assuming language learners represent 15% of each region's population (OECD, 2023), and integrating regional smartphone penetration rates (Statista, 2023). Findings indicate Duolingo's TAM growing from 1.193 billion learners in 2023 to 1.296 billion in 2032.

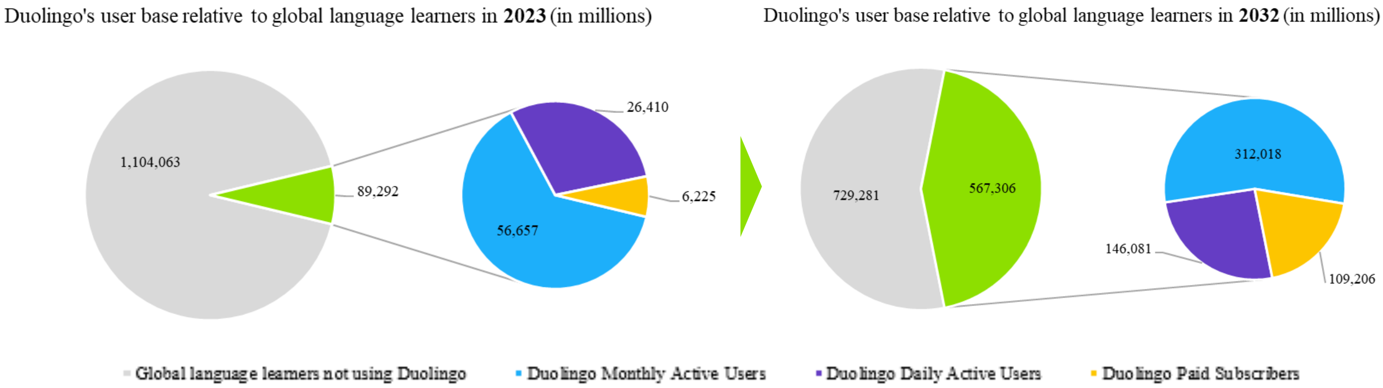
Figure 3: Duolingo's TAM in number of global language learners with smartphone access (created by the author)



[1] Total Addressable Market is the total market demand for a product or a service, representing the maximum revenue or maximum demand a business can achieve in a given market.
[2] United States and Canada, Europe, Middle-East and Africa, Asia Pacific, Latin America

Linking the analysis to the financial forecast discussed later, findings suggest a significant increase in market penetration from 7.8% monthly active Duolingo users (MAUs)[3] as a percentage of the TAM in 2023 to a solid 43.8% in 2032 and a rise in Duolingo paid subscribers[4] as a percentage of the TAM from 0.5% to 8.4% during the same period, underscoring the company's expanding market dominance and expected position as a clear market leader in digital language learning towards the end of the forecast period.

Figure 4: Duolingo's increasing market penetration throughout the forecast period (created by the author)



The graph above conveys that Duolingo is not only expected to greatly expand its presence in the language learning market, but also to succeed in converting MAUs and DAUs, who mainly contribute to revenue generation from advertising and in-app purchases, into Paid subscribers, who contribute to revenue generation through subscription fees. This will be elaborated upon in more detail in the company overview and the financial forecast sections.

[3] Monthly Active Users; defined as Duolingo users who engage with the mobile language learning application or the language learning section of the website each month. MAUs are reported for a measurement period by taking the average of the MAUs for each calendar month in that measurement period.
[4] Duolingo users who have an active subscription to Super Duolingo.

2. COMPANY OVERVIEW

Conceived by the innovative minds of German-Guatemalan entrepreneur Luis von Ahn and Swiss-born Severin Hacker, Duolingo emerged from the duo's aspiration to make language education universally accessible. Drawing from von Ahn's observations in Guatemala, where many faced steep costs to learn English, they initially envisioned a two-fold platform: teaching languages while leveraging users to translate online content. An early prototype had Spanish speakers translating Wikipedia articles as they learned English (GoodWhale, 2023). However, recognizing its limitations, the founders pivoted to a gamified, personalized learning platform. Duolingo debuted in 2012, following a private beta that offered six languages: English, Spanish, French, German, Portuguese, and Italian. Its rise was meteoric, boasting over 500 million registered users and a diverse course list spanning over 100 languages, from globally popular ones to unique offerings like High Valyrian[5]. With its innovative approach, Duolingo has not only revolutionized language learning but also earned accolades, even being likened to the addictiveness of Candy Crush by The New York Times (GoodWhale – Investing Simplified, 2023).

2.1. MISSION & STRATEGY

Duolingo's mission is to develop the best education globally and make it universally available. The company emphasizes its profound commitment to creating unparalleled educational resources and making them accessible to everyone globally. The leadership attributes their success to this mission-centric ethos. Rather than diverting most of their resources towards immediate benefits like performance marketing, they prioritize a long-term approach, consistently focusing on refining their products and fortifying their brand (Duolingo, 2021).

[5] High Valyrian is the constructed language in the TV series „Game of Thrones“. Duolingo incorporated High Valyrian language courses into its platform following its partnership with HBO Max to promote the „Game of Thrones“ prequel „House of the Dragon. “

The company's strategy is underscored by five components, forming a robust mechanism: grow users, teach better, grow subscribers, become the proficiency standard, and expand beyond language learning.

Figure 5: Duolingo's long-term strategy (Source: Duolingo)

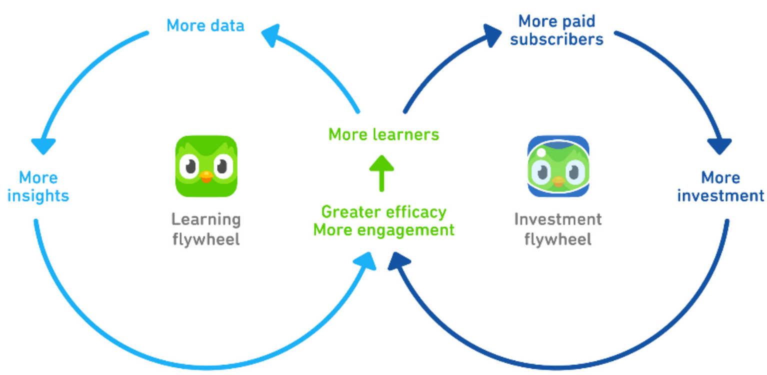
Duolingo recognizes that a surge in active users correlates with a rise in paid subscriptions, subsequently boosting revenues. Duolingo invests to refine its teaching approaches and solidify its standing as a proficiency standard, attracting an even broader user base. While they acknowledge the immense potential in the language learning sector, they perceive the broader education market to be even more promising. In subsequent years, they aspire to leverage their dominant position in language education to venture into other educational domains (Duolingo, 2021).

2.2. BUSINESS MODEL

Duolingo's language offerings can complement traditional language learning methods by providing a flexible, technology-based option for learners to supplement their existing study routines with additional practice and exposure to the target language. The company's business model leverages a freemium approach, providing no-cost access to educational content with the objective of transitioning a segment of this extensive user base to a paid subscription as they become more invested in the language learning experience. Since Duolingo offers all its educational content without a paywall, anyone can download and utilize the app indefinitely.

This freemium model has been pivotal in driving the company's growth and establishing its competitive edge, primarily through two self-reinforcing mechanisms: the learning flywheel and the investment flywheel. In the learning flywheel, a larger user base allows Duolingo to harness data analytics more effectively, enhancing both user engagement and learning effectiveness. As the products become more engaging and the learning experience more effective, users are more likely to recommend Duolingo to others, expanding the user base even further. The investment flywheel leverages the extensive user base and organic growth through word-of-mouth. This allows Duolingo to allocate capital more towards product innovation and data analytics than branding or performance marketing. As more users engage with Duolingo and transition into paying subscribers, the company can further invest in creating a more enjoyable, engaging, and effective learning experience. This not only boosts Duolingo's popularity and user base but also enhances the efficacy of its data analytics, further strengthening its competitive position.

Figure 6: Duolingo's business model (Source: Duolingo)

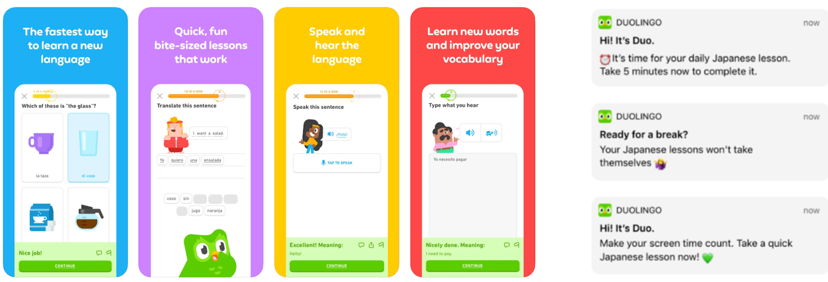


By the close of December 31, 2022, this accessibility propelled their user base to exceed 60 million MAUs for the preceding three months. Such a vast audience acts as ambassadors for Duolingo, bolstering its growth through word-of-mouth and allowing for selective marketing investments. It also contributes significantly to the company's data collection. With users completing more than 900 million exercises daily, Duolingo harnesses this data for expansive A/B testing and innovative AI methodologies, continually refining user engagement and effectiveness. Furthermore, the longevity of user commitment to Duolingo, often spanning several months or even years before opting for a subscription, ensures sustained revenue streams. As evidence, by December 31, 2022, paid subscribers constituted 7.8% of their average MAUs for the past year, a noticeable increase from 6.2% in the year ending December 31, 2021 (Duolingo, 2022).

2.3. Products

Duolingo’s product portfolio comprises the Duolingo Language Learning App, the premium subscriptions Super Duolingo and Duolingo Max, Duolingo ABC, Duolingo Math, Duolingo for Schools and the Duolingo English Test (DET). The Duolingo Language Learning App employs adaptive algorithms to personalize lessons based on users' proficiency levels and learning patterns. The app integrates a variety of exercises, from listening and translation tasks to speaking and vocabulary drills. Its distinct gamified elements, such as earning points and maintaining streaks, incentivize consistent practice. Moreover, Duolingo's iconic green owl mascot further enhances user engagement through playful reminders and encouragements, making the learning process fun and effective. Figure 7 below is intended to provide the reader with an idea of the interface of Duolingo’s language learning platform and of the reminders sent to learners.

Figure 7: Attributes and characteristics of Duolingo’s language learning platform (Source: Duolingo)



Overall, the app offers courses in 43 languages, 39 for English speakers (Duoplanet, 2023). Although Duolingo provides free course material, the premium subscriptions, known as Super Duolingo[6] and newly launched Duolingo Max[7], present users with extra features to enhance users' learning progress. In 2021, Duolingo rolled out a family package, accommodating up to six subscribers within a singular yearly plan (Duolingo, 2022).

Launched in 2020, Duolingo ABC is a complimentary application geared towards imparting foundational literacy skills to young learners. Crafted by educational specialists, the app adheres to the Common Core State Standards and is structured around the guidelines set by the National Reading Panel. Debuted in 2022, Duolingo Math is a complementary application catering to students who wish to delve into primary math subjects and adults seeking to hone their mental arithmetic abilities through brain training exercises (Duolingo, 2022). Duolingo for Schools is a complimentary web-based utility designed to facilitate educators in incorporating the Duolingo platform into organized learning settings, such as classrooms. With this tool, educators can set up a dashboard for their classes, designate specific Duolingo lessons to pupils, and monitor their advancement through the material (Duolingo, 2022).

Introduced in 2016, the DET serves as an on-demand online evaluation of English proficiency. Accessible to anyone with a stable internet connection, computer, and webcam, the test offers unparalleled convenience, allowing takers to attempt it from any location and at any moment. Uniquely, it employs a computer adaptive methodology, adjusting its difficulty based on the participant's performance, and typically concludes in under an hour. As of 2023, the standard charge for the test stands at $59, which is a $10 increase compared to 2022 (Duolingo, 2023).

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[6] With Super Duolingo, users do not see ads and receive unlimited hearts (in-app digital items needed to proceed after making mistakes), allowing for learning without interruptions.

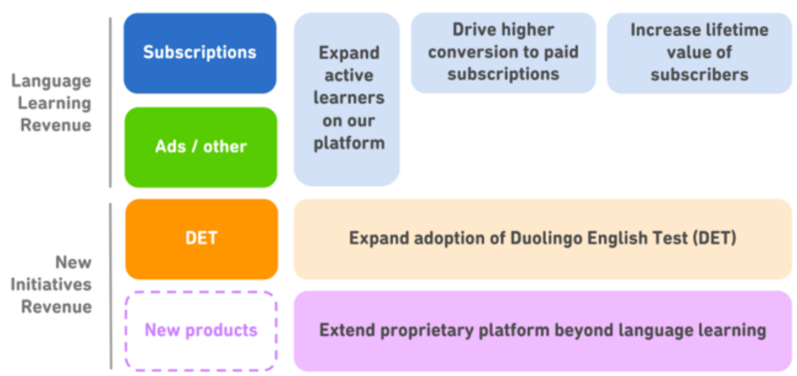
[7] Duolingo Max is a new subscription that provides an enhanced and more interactive learning experience. It includes all the benefits of Super Duolingo, along with two new AI-powered features: "Explain My Answer" and "Roleplay".

The value and acceptance of this test is evident as over 3,800 global higher education institutions recognized the test as a valid indicator of English proficiency for international admissions. This list boasts prestigious names such as Yale, Stanford, MIT, Duke, and Columbia, and covers the top 25 undergraduate programs by international enrollment.

2.4. Revenue Streams

Duolingo currently generates revenue from four distinct sources that can be separated into two main categories. First, revenue from language learning, and second, revenue from new initiatives. Language learning revenue is revenue from premium subscriptions, advertising and in-app purchases (IAPs) of digital items, while revenue from new initiatives is currently only composed of the sale of its English test but expected to be enhanced through new products beyond language learning. Subscription revenue is from the sale of the premium accounts Super Duolingo and Duolingo Max discussed in the section above. The second biggest stream is advertising revenue via Duolingo's free learning app and includes the sale of display and video ads delivered through advertising impressions. Collaborations with major programmatic advertising networks facilitate the monetization of their ad inventory. The advertising revenue hinges largely on the number of non-paying users, their engagement duration. The third revenue stream is revenue generated from in-app purchases, where learners can buy singular app benefits. The fourth revenue stream is the DET (Duolingo, 2022).

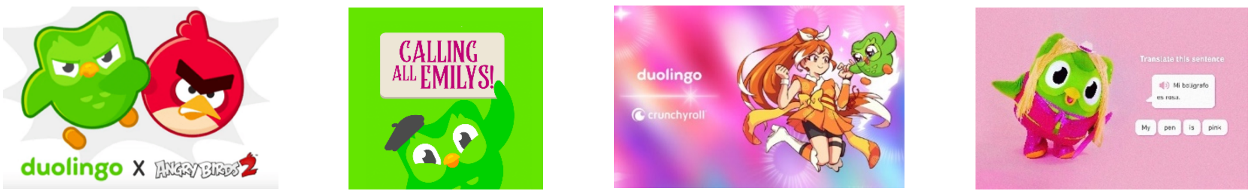
Figure 8: Duolingo's targeted actions at driving its distinct revenue streams (Source: Duolingo)



2.5. Marketing Strategy

For nearly a decade, the growth of Duolingo's learner base has been fueled organically, primarily through word-of-mouth recommendations. In the recent past, the company has begun allocating resources to marketing endeavors to reinforce its organic growth and bolster the reach of its existing users. The components of Duolingo's sales and marketing strategy encompass brand campaigns, owned media marketing[8], paid acquisition[9], and geographic expansion (Duolingo, 2022). Duolingo has enhanced its brand visibility through online and offline campaigns that generate media attention, encourage social media sharing, and perpetuate its word-of-mouth growth. Instead of relying solely on promotional content, the company harnesses its distinct brand identity on social platforms, crafting entertaining content in sync with viral trends to spur user engagement and growth organically[10] (Duolingo, 2022). Figure 9 below illustrates a series of marketing campaigns led by Duolingo in cooperation with Netflix, Crunchyroll, Rovio Entertainment and Warner Bros.

Figure 9: Duolingo's recent marketing campaigns (Source: Duolingo)



Lastly, in regions where Duolingo's organic reach is still budding but holds robust potential, such as the Indian market (The Financial Express, 2023), the company brings seasoned local marketing professionals on board to drive geographic expansion (Duolingo, 2022).

[8] Owned media comprises digital marketing channels that a company exercises complete control over, such as their branded website and social media. Duolingo makes extensive use of its TikTok channel and Instagram account, where it has a high number of followers.
[9] Paid acquisition refers to acquiring a new customer through a paid marketing channel.
[10] For example, Duolingo gave out a free membership to people named „Emily" after the first season of the Netflix series „Emily in Paris. " They also partnered with Jewish Delis to offer free bagels to people who ordered in Yiddish after they launched their first Yiddish course.

3. Financial Forecast

In this analysis and valuation of Duolingo, I have consciously decided against reformulating the company's financial statements. This decision stems primarily from the integrated nature of Duolingo's business operations, which do not distinctly separate into core and non-core segments. Furthermore, the absence of financial debt in Duolingo's capital structure negates the need for adjustments related to financing activities. Additionally, Duolingo's consistent revenue stream, primarily driven by its freemium model and minimal diversification into non-operational investments, supports the view that a traditional reformulation would not yield significant insights into its financial health or operational efficiency.

3.1. Income statement forecast

Income statement forecasting is integral to valuation, as it offers vital insights into a firm's projected financial performance and intrinsic value. It is extensively used by companies and investment banks to present forward-looking statements (Higgins, 2011). This forecasting process involves linking line items to key value drivers, which assists in constructing estimated financial statements and free cash flows, thereby playing a significant role in firm valuation and forecasting stock prices (Vélez-Pareja, 2006).

3.1.1. MAU, DAU & Paid Subscribers

Revenue is the key driver in Duolingo's income statement, necessitating a detailed forecast. The forecast of Duolingo's revenue streams is anchored in three primary metrics: MAUs, DAUs[11] and paid subscribers. This aligns with the company's operational strategy underpinned by its freemium model. Initially, Duolingo focuses on attracting MAUs, who engage with the

[11] Daily Active Users are defined as Duolingo users who engage with the mobile language learning application or the language learning section of the website each calendar day. DAUs are reported for a measurement period by taking the average of the DAUs for each day in that measurement period.

platform at least once monthly. These users primarily contribute to advertising revenue and in-app purchases, given their exposure to ads in the free version and occasional procurement of digital items. Subsequently, a proportion of MAUs, quantified by the user engagement ratio, transition into DAUs. These users, engaging daily, continue to generate revenue through ads and in-app purchases, as they have yet to choose to upgrade to the paid version. The final transition in this model involves converting DAUs into paid subscribers at a rate defined as the conversion rate. This pivotal step marks a shift in revenue generation: paid subscribers, having opted for the premium version of the app, no longer encounter advertisements, and have no need for in-app purchases, thereby pivoting the revenue source exclusively to subscription fees. The initial phase of the forecasting process involves predicting MAUs, DAUs, and paid subscribers for Duolingo. This is achieved by analyzing historical quarterly data from Q1 2020 to Q3 2023. For the short-term forecast, extending up to Q3 2024, the Holt-Winters exponential smoothing model is utilized. This model is adept for short-term forecasting in scenarios where data exhibits seasonality, as is the case with Duolingo's MAU growth. For example, Duolingo experiences fluctuating engagement patterns, such as increased usage during school commencement periods, which this model can accommodate (Eusébio, Camus & Curvelo, 2015). Please find the optimized model parameters in Table 3 in the appendix.

After establishing short-term forecasts up to Q3 2024, the analysis proceeds with a long-term projection. This involves utilizing the historical quarterly data for the user engagement ratio and conversion rate. A trend analysis technique is applied to each metric for this extended forecast, which spans until the end of 2030. The growth patterns for MAUs and the user engagement ratio follow an exponential trend, indicating a rapid increase over time. Conversely, the conversion rate demonstrates a linear trend, suggesting a steady, uniform rate of change. These identified trends are critical in extrapolating future values for MAUs, the user engagement ratio, and the conversion rate during Duolingo's high-growth phase (see Figures

10 to 12 in the appendix). In the final step, the forecasted MAUs are multiplied by the projected user engagement ratio to yield the expected number of Daily Active Users. Similarly, applying the forecasted conversion rates to these DAUs provides an estimation of paid subscribers. Table 4 showcases the historical CAGRs alongside the resulting forecasted ones and Figure 15 in the appendix shows the MAU, DAU and paid subscriber growth in the base case throughout the projection period.

Table 4: MAU, DAU and Paid Subscriber CAGRs (created by the author)

	CAGRs		
	2019-2022	*2023-2030*	*2031-2032*
MAUs	30.5%	32.2%	0%
DAUs	46.4%	41.2%	10.2%
Paid Subscribers	67.1%	46.6%	10.5%

3.1.2. Revenue Streams

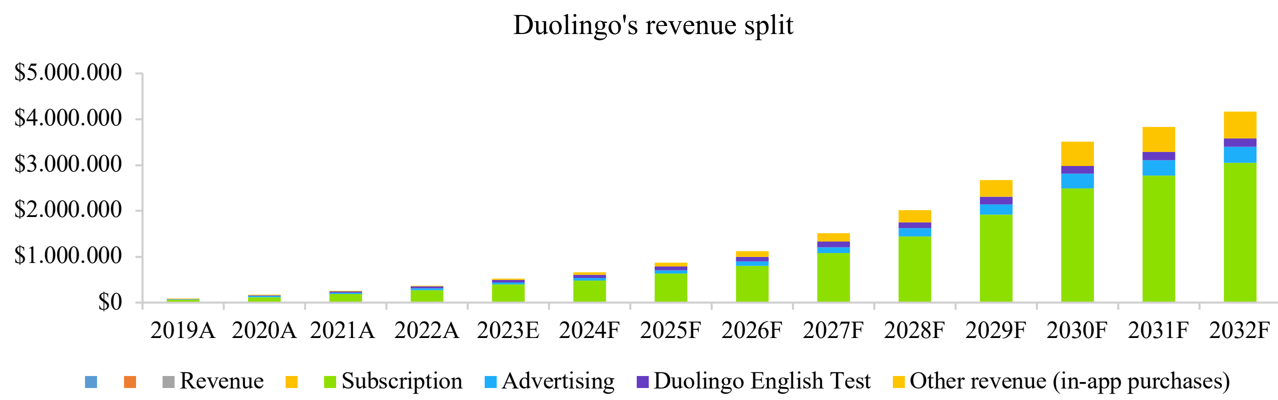
The next phase in the revenue forecast focuses on the specific streams, starting with subscription revenue. It is calculated by multiplying the number of paid subscribers by the average subscription revenue per subscriber. Over the forecast period, a notable trend is anticipated in the average revenue per subscriber: a gradual decline. This expected decrease is attributed to a shift in subscriber preferences. Increasingly, subscribers are projected to opt for longer-term subscription plans, notably the annual plan, over shorter-duration options like the one-month or six-month plans. Additionally, the growing popularity of the family plan, which accommodates up to six users at a comparatively lower cost, is also expected to contribute to the overall reduction in average revenue per subscriber.

The projection of advertising revenue forms the subsequent component of the revenue forecast. This estimation is grounded in a regression analysis, where historical quarterly advertising revenue is regressed against the historical quarterly DAU. The linear relationship identified between these two variables forms the basis for forecasting future advertising revenue. This approach assumes a consistent correlation between the number of active users and the generated ad revenue, reflecting the direct impact of user engagement on advertising income. The regression output demonstrates a significant positive correlation between Duolingo's Daily Active Users (DAUs) and its advertising revenue, with approximately 55.8% of the variation in ad revenue being explained by DAUs. The model's statistical significance is confirmed by an F-statistic of 16.43 and a p-value of 0.0014, indicating a very low probability that this relationship is due to chance. Each additional DAU is predicted to increase ad revenue by about 0.32 units, supporting the use of DAUs as a reliable predictor for future advertising revenue projections (see Figure 13 in the appendix).

Revenue from in-app purchases is estimated utilizing the same econometric approach: a regression analysis of historical data against DAUs to delineate the underlying linear relationship. This methodological choice is predicated on the understanding that in-app purchases are predominantly—almost exclusively—attributable to the activity of daily users. The regression summary for Duolingo's in-app purchases indicates an extremely strong and statistically significant relationship with Daily Active Users (DAUs). The R Square value of approximately 0.977 suggests that nearly 97.7% of the variability in in-app purchase revenue can be accounted for by changes in DAUs, denoting a very high degree of correlation. The F-statistic is exceedingly high at 550.41, with an effective associated p-value at zero, affirming the regression's validity. The coefficient for DAUs is about 0.597, meaning that for each unit increase in DAUs, the in-app purchase revenue increases by nearly 0.6 units. This robust model underscores the substantial influence of daily user engagement on the revenue generated from in-app purchases (see Figure 14 in the appendix).

Finally, revenue projections for the DET are calculated by multiplying the estimated number of test takers by the set price per test. The model assumes a deceleration in the growth rate of test takers over the projection period. Concurrently, a gradual increase in the test price is anticipated annually, justified by the current pricing disparity between the DET and its more expensive counterparts, such as the IELTS and TOEFL. It is posited that the DET's price will progressively align with these established assessments while maintaining a competitive, lower cost. Please refer to Figure 16 below and to Table 6 in the appendix for a summary of the forecasted revenue figures.

Figure 16: Revenue forecast (in thousands) (created by the author)



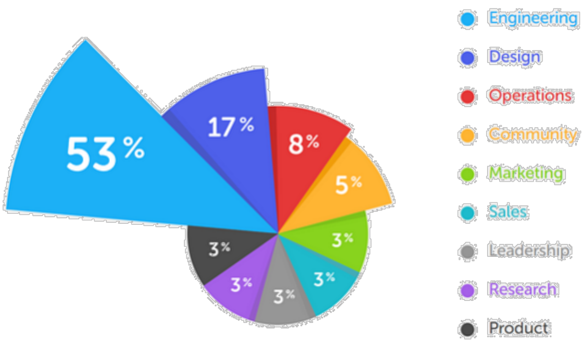
3.1.3. Cost of Revenues and Operating Expenses

Duolingo's cost of revenues, predominantly composed of third-party payment processing fees and hosting expenses, also includes smaller costs related to labor and technology infrastructure (Duolingo, 2023). From 2019 to 2022, cost of revenues has been growing at a CAGR of 68.6% and the firm saw a margin reduction in these costs from 29.3% to 26.9%, indicating efficiency gains. This trend, reflecting higher gross margins, owes mainly to improved subscription retention and reduced Google Play store charges. Projections until 2030 suggest a continued margin decline, stabilizing at 21%, postulated on scaling advantages in payment processing negotiations (McKinsey & Company, 2023) and technological efficiencies in hosting (Bain &

Company, 2023). This results in a forecasted CAGR of 28.8% during the growth period from 2023 until 2030, and a CAGR of 7.6% thereafter.

Duolingo's R&D expenses, directed toward new products and feature upgrades, include salaries and stock-based compensation for a growing cohort of engineers, designers, and product managers. The company's iterative development process, characterized by user testing and gradual enhancements, necessitates significant investment (Duolingo, 2022). Duolingo commits a substantial portion of its revenue to R&D to improve its platform and support user base expansion, evidenced by R&D costs having grown at a CAGR of 67.9% during the last three years, being the most significant expenditure relative to revenue from 2019 to 2022 - 44.6%, 32.8%, 41.4%, and 40.7%. As efficiencies improve, these expenses are expected to normalize to around 16% of revenue, which results in a projected CAGR of 20.6% until 2030, and a CAGR of 2% thereafter. The decrease relative to revenue is justified by the company’s decision to start capitalizing slightly larger portions of their R&D expenses compared to the last years to better reflect the long-term value and profitability of their product initiatives, such as Duolingo Max, math, and music. It is also justified by the expectation of generally decreasing R&D productivity over time, indicating diminishing innovation opportunities as the industry matures (G. Erickson & B. Bayus, 2001). As Duolingo's user base and product offerings stabilize, the need for large-scale, foundational R&D shrinks, transitioning towards more incremental enhancements and optimizations. Furthermore, as revenues grow, even sustained R&D investment will constitute a smaller percentage of total revenue. Additionally, the company's increasing experience and expertise in R&D are expected to lead to more efficient development processes, further contributing to the expected decline in R&D intensity (Mingli Xu, Wei Yang, Lirang Pang & Dongmin Kong, 2017). Figure 17 below shows that in 2021, more than half of Duolingo’s employees were software engineers, and 17% product designers. This presents a significant divergence from the approach of one of Duolingo´s main competitors, Rosetta Stone, where just over a quarter of its workforce is employed in software engineering and design, as indicated by data from LinkedIn Premium.

Figure 17: Duolingo's workforce (Source: Duolingo)

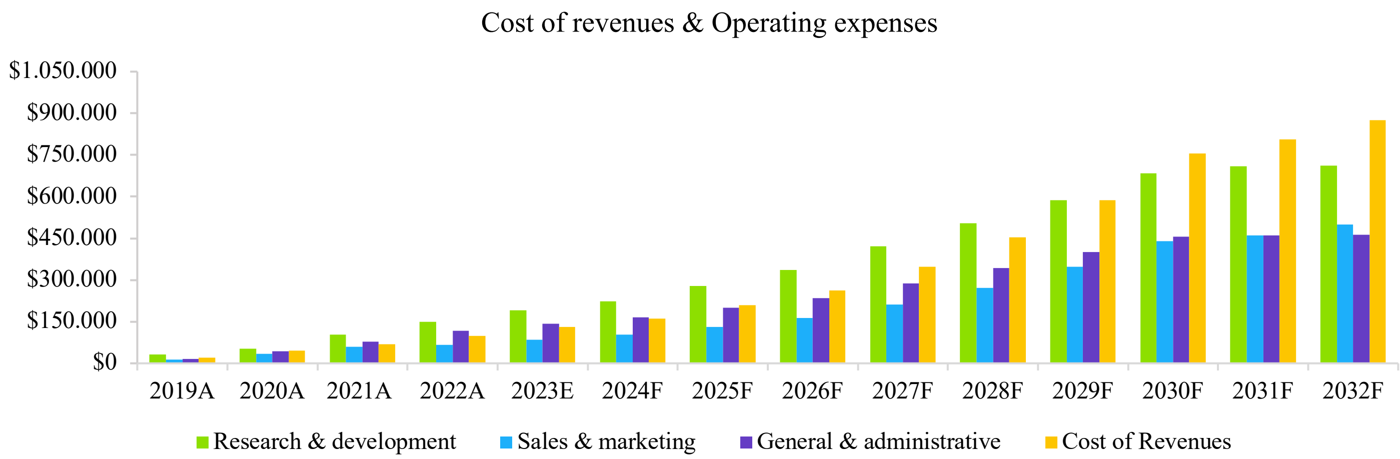


Duolingo's sales and marketing (S&M) expenses encompass advertising, digital campaigns, field activities, event sponsorships, and associated staff compensation, including stock-based remuneration. These costs also include amortizing non-revenue-generating software for marketing purposes (Duolingo, 2022). From 2019 to 2022, S&M expenses as a percentage of revenue were 21.2%, 21.6%, 23.6%, and 18.1%, having grown at a CAGR of 65.3%. The projection extends this trend towards a further reduction, anticipating that the ratio will narrow to 12% post-2030, growing at a CAGR of 26.8% until 2030 and 6.7% thereafter. As the user base grows, network effects and increased word-of-mouth lead to lower customer acquisition costs and therefore reduced marketing spend (McKinsey & Company, 2010).

Duolingo's general and administrative (G&A) expenses encompass compensation for management and support staff, including stock-based remuneration, and are associated with various administrative departments such as finance, legal, and human resources. They also include professional service fees, insurance, facilities overheads, and regulatory compliance costs for SEC and Nasdaq Global Select Market listings (Duolingo, 2022). Duolingo's G&A expenses as a percentage of revenue have been reported at 23.1%, 27.0%, 31.3%, and 31.9% from 2019 to 2022, respectively, and they grew at a CAGR of 94.7%. Moving forward, while

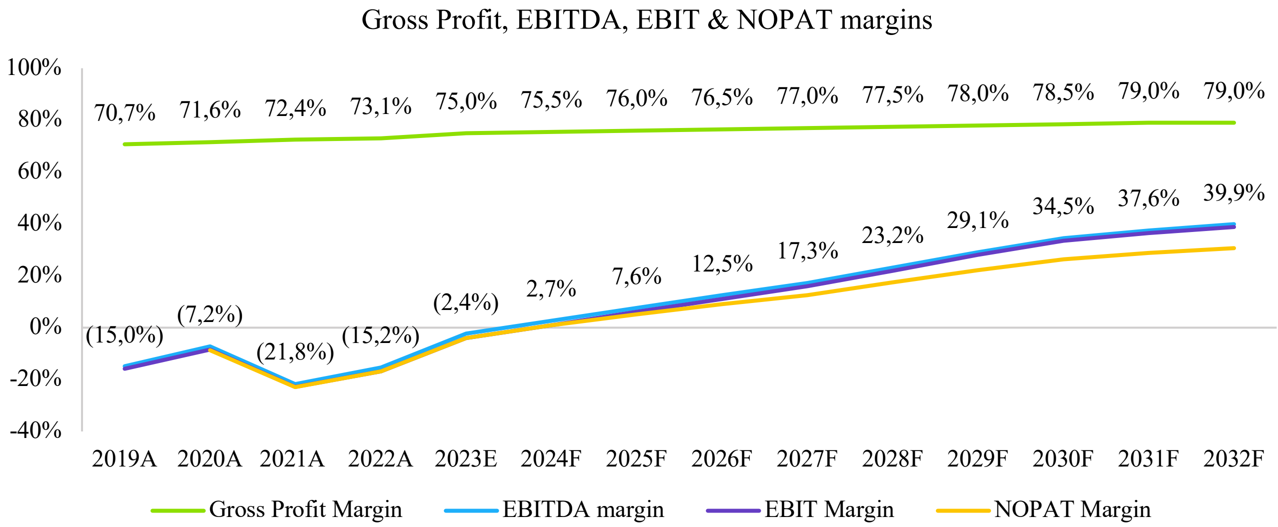
G&A costs are anticipated to increase in total dollars due to business expansion, these percentages are projected to decline through the end of 2030, stabilizing at the software industry average of around 11% (Kelley, 2017), growing at a CAGR of 18.6% until 2030 and 0.6% afterwards. As Duolingo scales its operations, administrative efficiencies increase, and certain fixed costs, such as facilities and regulatory compliance, become a smaller fraction of total revenues. Furthermore, the company's investment in automation and process improvements within administrative functions will lead to lower incremental costs over time. Figure 18 below shows the evolution of operating expense margins throughout the projection period.

Figure 18: Forecast of Duolingo's cost of revenue and operating expenses (created by the author)



The forecast of cost efficiencies at Duolingo reveals a declining trajectory of revenue, R&D, S&M, and G&A expenses as a percentage of revenue through the projection period, with a concomitant favorable impact on profitability margins. From 2019 to 2022, the gross profit margin improved from 70.7% to 73.1%. Projected growth to 2030 anticipates gross profit margin peaking at 79.0%, with the EBITDA margin recovering from a 15.2% deficit in 2022 to 39.9% in 2032. EBIT and NOPAT margins are also expected to strengthen to 38.8% and 30.7%, respectively. Beyond 2030, a plateau in profitability margins is expected, reflecting a shift to sustained profitability and market stability. The projected profit margins are shows in the Figure 19 below.

Figure 19: Duolingo's forecasted profit margins (created by the author)



3.2. BALANCE SHEET FORECAST

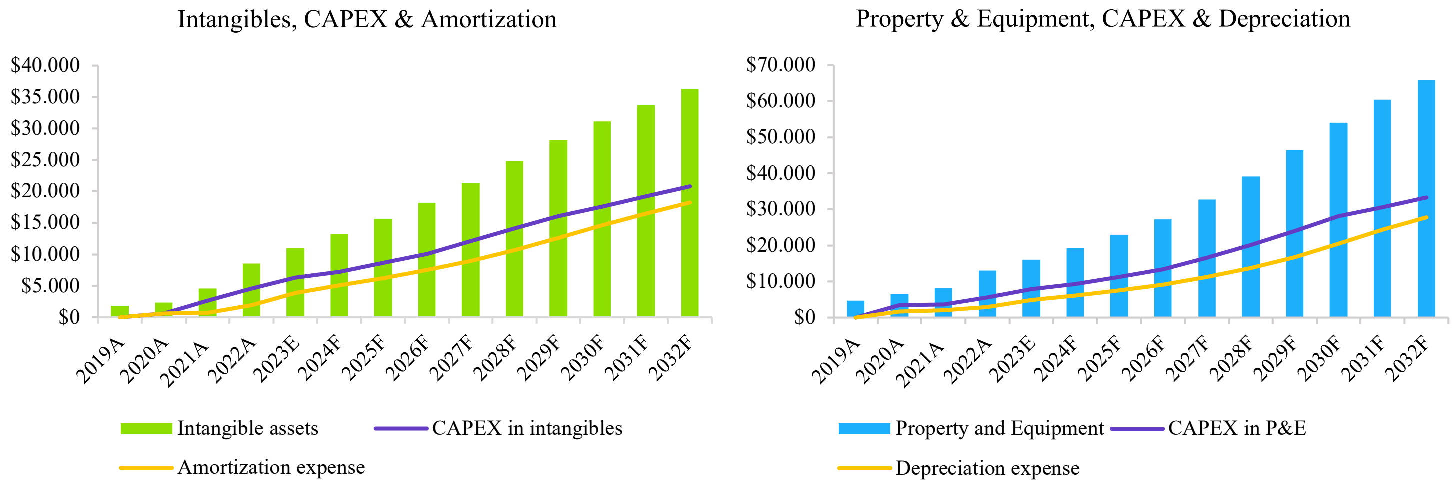
3.2.1. Non-Current Assets and Net Working Capital (NWC)

Duolingo's intangible assets primarily consist of capitalized software. The company capitalizes costs for developing its platform and internal software applications, following specific authoritative guidelines. The capitalization process begins once initial development is completed, the project receives management approval and funding, and the project will likely be finished and the software used as intended. Capitalization ceases when the software is complete and ready for its intended purpose, including extensive testing. These costs are then amortized over the asset's estimated useful life, typically around three years. The company also capitalizes costs for significant upgrades and enhancements expected to add functionality. In contrast, expenditures for maintenance, minor upgrades, and enhancements are expensed as incurred. Costs incurred before meeting these criteria, along with training and maintenance expenses, are recorded as research and development expenses. From 2019 to 2022, capitalized software expenses and purchases of intangibles expanded at a CAGR of 167.4%, but this increase needs to be normalized for the effect of Duolingo’s already discussed acquisition of Gunner for $4.5 million in 2022. In projecting intangible assets from 2022 to 2030, capital expenditures in intangibles are expected to increase as a percentage of revenue. The resulting CAGR for the forecast period is estimated at 18.3%, and 8.9% thereafter. This trajectory mirrors the productization of R&D projects and the increased predictability of future benefits. It explains the strategic shift from expensing R&D expenses to capitalizing them, as Duolingo's innovation efforts yield more definable and durable technological add-ons to its language learning platform.

Duolingo's property and equipment (P&E), encompassing leasehold improvements, furniture, fixtures, and office equipment (Duolingo, 2022), has substantially grown. The CAGR of purchases of P&E from 2019 to 2022 was approximately 28.4%. From 2022 to 2030, the CAGR is projected to be around 22.4%, and 8.9% thereafter. The forecast for P&E follows a similar logic to that of intangibles, with capital expenditures in P&E set as a percentage of revenue. This rise in CAPEX for P&E is justified by the requirement of larger and more numerous office spaces to accommodate an expanding workforce and the necessary investment in leasehold improvements and office equipment and continuous enhancement of technological infrastructure, including advanced computing and networking equipment, to support innovative product development and efficient operations (Duolingo, 2022). Amortization of intangible assets and depreciation of P&E has been forecasted as a percentage of beginning intangible assets and P&E respectively, in line with the historical average and increasing towards the end of the projection period as revenue growth is slowing down. Duolingo's operating lease right-of-use assets are forecasted as a percentage of revenue, explicitly calculated as a 4-year moving average. It is anticipated that by 2027, deferred tax assets and liabilities will go to zero, and that

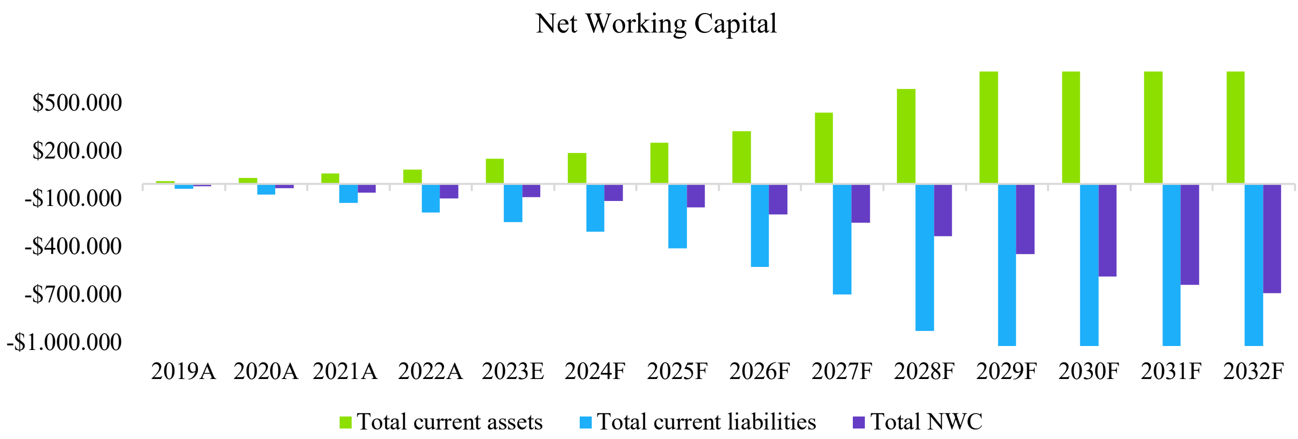
Duolingo’s effective income tax rate to the statutory tax rate of 21%. This assumption is based on the expectation that temporary differences between the accounting and tax treatment of income and expenses will diminish as the company's taxable income aligns more closely with its accounting income. This alignment reflects a stabilization of Duolingo's fiscal position and a reduction in timing differences that create deferred tax assets and liabilities.

Figure 20: Forecast of Duolingo’s intangible assets and property & equipment (created by the author)



Proceeding to NWC, accounts receivable is estimated based on the average receivable days observed historically, with a constant forecast of approximately 65 days. This duration aligns with industry norms, suggesting a prudent approach to credit terms in line with sector standards. Deferred cost of revenues and prepaid expenses, alongside other current assets, are projected by applying the historical average of these items as a percentage of revenue, ensuring continuity in the estimation process. Similarly, accounts payable are forecasted based on an average of historical payable days, maintained around 25 days. This relatively short payment period reflects Duolingo's strategic utilization of early payment discounts, optimizing cash outflows related to accounts payable. Deferred revenue, a significant component of current liabilities, is projected as a consistent percentage of subscription revenue, drawing from the historical average. The same methodological consistency applies to accrued expenses and other current liabilities. As Duolingo's operations have scaled, NWC has increasingly trended negative year-over-year. This pattern is characteristic of software companies operating on a subscription-based model, where significant deferred revenues are typical. Such companies often receive payments before recognizing revenue, leading to significant deferred revenue balances (Universal CPA Review, 2022). This phenomenon, while contributing to the negative trajectory of NWC, indicates a robust business model that benefits from upfront cash flows (CFO Magazine, 2012).

Figure 21: Forecast of Duolingo's net working capital (created by the author)



3.2.2. Non-Current Liabilities

On the non-current liability side, Duolingo has historically maintained a debt-free capital structure, reflecting its equity-financed growth trajectory through multiple rounds of venture capital funding with investors such as Google's CapitalG and General Atlantic (Crunchbase, 2023), culminating in the IPO in 2021 that further bolstered its liquidity. In the forecast period, given Duolingo's substantial cash reserves and the cash-liberating effect of its negative working capital cycle, it is not anticipated that the company will resort to raising financial debt. Duolingo's long-term liabilities are primarily constituted by obligations under operating leases. These obligations, representing future non-cancelable minimum rental payments, are projected as a percentage of revenues, calculated using the historical average.

3.3. CASH FLOW STATEMENT

In constructing an integrated financial statement model, modeling the cash flow statement is critical, as it ensures the reconciliation and balancing of the balance sheet. The ending cash balance carries forward into the cash and cash equivalents line item of the balance sheet, serving as a critical linkage that aligns total assets with total liabilities and stockholders' equity, thereby affirming the model's accuracy and coherence (Hayen, 1983). In the indirect method of cash flow calculation, net income is adjusted for non-cash transactions, changes in working capital, and deferrals or accruals to convert accrual-based net income to cash-based net income (CFA Institute, 2023). In Duolingo's cash flow statement, the starting point is the net income or loss as reported in the income statement (Duolingo, 2023). Reconciliation adjustments are made by adding back non-cash charges such as D&A and stock-based compensation and adjusting for changes in NWC. The cash flow from investing is determined by deducting the capital expenditures on software, intangible assets, and P&E. Regarding cash flow from financing activities; it is projected to be nil throughout the forecast period, under the assumption that Duolingo will neither incur new financial debt nor engage in equity financing activities such as issuing or repurchasing common stock or issuing or exercising stock options.

4. Firm Valuation

4.1. Cost of capital

Duolingo's cost of capital estimation is atypical, given its zero-debt financing. While operating lease obligations are sometimes equated to financial debt in capital structure analyses, they differ fundamentally as they do not entail traditional financing costs such as interest or dividends (Mergers & Inquisitions, 2023). Therefore, Duolingo's Weighted Average Cost of Capital (WACC) aligns with its cost of equity due to the absence of debt. Despite this, for analytical completeness and standard practice alignment, this paper will compute WACC according to the standard formula.

4.1.1. Risk-Free Rate & Equity Risk Premium

The risk-free rate in financial theory denotes the expected return on an investment devoid of risk (Damodaran, 2010), typically approximated by the yield-to-maturity on government debt matching the forecast horizon (Hall, 2007). For Duolingo, which earns substantial revenue in the U.S., the risk-free rate aligns with the yield on U.S. government bonds. Accordingly, the 10-year U.S. Treasury bond yield, at 4.091%, is the risk-free rate, in line with the suggested duration for cash flow forecasts (Damodaran, 2010). The equity risk premia utilized in this study were sourced from Damodaran (2023). In determining the equity risk premium for Duolingo, the company's revenue split is used as a proxy for its geographical exposure. Revenue percentages were attributed to the respective country-specific equity risk premiums. This methodology yielded an aggregate equity risk premium of 5.516%.

4.1.2. Cost of Equity

To compute the WACC, one must determine the desired capital structure, as well as ascertain the cost of debt (rD) and the cost of equity (rE) (Kumar, 2016). The formula of the CAPM is expressed as:

$$r_E = r_f + ß_E(r_M - r_f) \quad , \tag{1}$$

where r_E is the cost of equity, r_f the risk-free rate, $ß_E$ the levered beta and r_M the market return (Perold, 2004). $ß_E$ is estimated by dividing the covariance of the stock's return with the market portfolio by the variance of the market return (Damodaran, 2011). The betas for Duolingo and its peer group were computed by analyzing their 5-year weekly logarithmic returns and regressing them against the logarithmic returns of the MSCI World Index. To calculate and compare unlevered betas, Hamada's equation (Alam, 2022) is used:

$$ß_U = \frac{ß_L}{1 + \frac{(1-t) * D}{E}} \quad , \tag{2}$$

where $ß_U$ is the unlevered beta, $ß_L$ is the levered beta, t is the statutory tax rate, D is the market value of debt and E is the market value of equity. The use of an adjusted beta for Duolingo's valuation is justified by its ability to merge historical data with the tendency of a security's beta to move toward the market average. Compared to using raw beta, this approach provides a more accurate and forward-looking assessment of the company's future risk and cost of equity (Echterling & Eierle, 2015). The adjustment formula is expressed as:

$$ß_{adjusted} = \frac{2}{3}\, ß_{raw} + \frac{1}{3}\, ß_m \quad , \tag{3}$$

where $ß_{adjusted}$ is the adjusted beta used for the computation of the cost of equity, $ß_{raw}$ is the levered beta and $ß_m$, the mean reverting level, equals 1. (Echterling & Eierle, 2015). Duolingo's resulting adjusted beta is equal to 1.157. With the risk-free rate, the equity risk premium, and the adjusted beta as foundational inputs, the CAPM formula (1) yields a computed cost of equity of 10.493%.

The balance sheet forecast assumes that Duolingo will refrain from incurring long-term financial debt until 2032. Beyond this point, the company is expected to continue with its current strategy regarding its capital structure, effectively issuing no interest-bearing financial debt. This approach is conservative, acknowledging that Duolingo could benefit from tax shields on debt interest if it were to leverage debt financing (Investopedia, 2023).

4.1.3. Weighted Average Cost of Capital

The WACC formula can be written as follows:

$$WACC = \frac{E}{EV} * r_E + \frac{D}{EV} * r_D * (1 - t) = 10.493\% \ , \tag{4}$$

with r_E = 10.493%, r_D = 0%, $\frac{E}{EV}$ = 1 and $\frac{D}{EV}$ = 0. As outlined in the introduction to the cost of capital chapter, long-term obligations under operating leases are excluded from the WACC calculation. This exclusion is because these obligations do not entail actual funding costs, differing fundamentally from interest-bearing forms of debt (Mergers and Inquisitions, 2022).

4.2. INTRINSIC VALUATION – DISCOUNTED CASH FLOW ANALYSIS

This paper employs the DCF methodology to estimate Duolingo's target share price, distinguishing between equity and firm valuation approaches. The equity valuation discounts cash flows to equity at the cost of equity, whereas firm valuation computes enterprise value by discounting unlevered cash flows at the WACC (Damodaran, 2010). The enterprise value is derived using the Gordon Growth model to determine the terminal value's present value (Gordon, 1959; Damodaran, 2010):

$$EV_o = \sum_{t=1}^{n} \frac{FCFF_t}{(1 + WACC)^t} + \frac{TV}{(1 + WACC)^n} \ , \tag{5}$$

where $FCFF$ are the free cash flows to the firm and TV the terminal value calculated as:

$$TV = \frac{FCFF_n * (1 + g)}{WACC - g} \ , \tag{6}$$

where g is the perpetual growth rate. Next, to calculate the equity value of the firm, the formula is the following:

$$EqV_o = \sum_{t=1}^{n} \frac{FCFE_t}{(1+Ke)^t} + \frac{TV}{(1+Ke)^n} \quad , \tag{7}$$

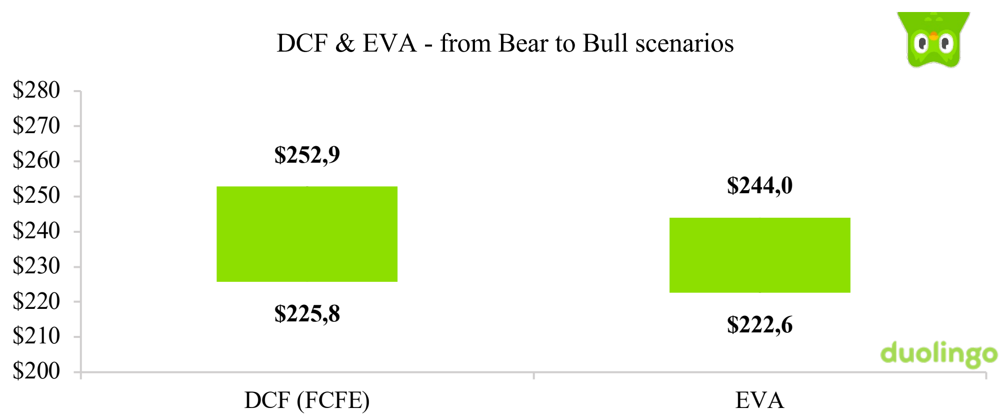
where $FCFE$ are the free cash flows to equity and TV the terminal value calculated as:

$$TV = \frac{FCFE_n \ * (1+g)}{Ke - g} \quad , \tag{8}$$

where Ke is the cost of equity and g the perpetual growth rate. The economic growth rate method is applied to project Duolingo's perpetual cash flow expansion (Damodaran, 2010). Adopting a country's long-term GDP growth rate as the perpetual growth rate benchmark ensures realistic and sustainable valuation projections (Corporate Finance Institute, 2023). Considering Duolingo's global reach, the global GDP growth forecast of 2.4% to 3% per annum (IMF, 2023; OECD, 2023) serves as a suitable proxy. Consequently, a conservative perpetual growth rate of 2.4% is utilized in the valuation. Under Modigliani and Miller's framework, free cash flow is usually computed as all cash distributed to both debt and equity holders, without retaining any for investments like short-term marketable securities (Modigliani & Miller, 1958). For Duolingo, which holds no debt and does not allocate surplus cash to marketable securities, FCFF directly equals FCFE. This FCFE is derived by adjusting net income for non-cash charges, subtracting capital investments and changes in net working capital. Using a 10.49% cost of equity, the discounted FCFE approach values Duolingo's equity at $239.0 per share. The FCFF method corroborates this valuation since, for Duolingo, FCFF is equivalent to FCFE, and WACC matches the cost of equity (Canessa & Jarrell, 2022). As there is no present value of the tax shield of debt to consider, given that Duolingo is not expected to take on debt in the foreseeable future, the Adjusted Present Value (APV) would arrive at the same target share price of $239.0. The Economic Value Added (EVA) method determines annual economic profit by multiplying the excess of Return on Invested Capital (ROIC) over the cost of capital by the average invested capital of the period. To calculate the equity value, one sums the forecasted annual economic profits and subtracts net debt. Applying the method to Duolingo, a share price of $233.1 is calculated (see Tables 10 and 11 in the appendix for the valuation calculations).

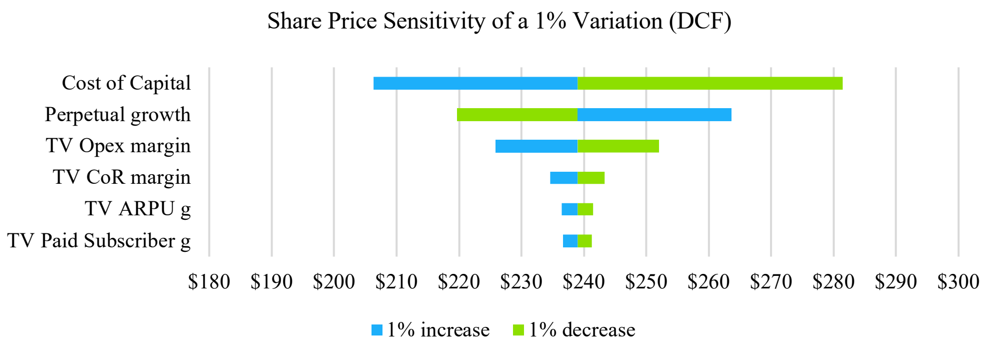
Duolingo's valuation is nuanced through three scenarios - optimistic, neutral, and pessimistic - each accounting for different growth driver outcomes. In the optimistic case, technological uptake spurs user expansion in Africa and Latin America, and successful integration of new subjects alongside advanced AI and virtual technologies elevates subscription revenue. The neutral scenario assumes expected performance from these integrations, while the pessimistic scenario anticipates a weak response from users to new offerings, stifling subscription revenue. Introducing new subjects is projected to expand Duolingo's addressable market across all scenarios. Advertising revenue fluctuations are modeled on cost-per-click variations: an optimistic increase aligns with higher demand for ad space on Duolingo, whereas a pessimistic decrease mirrors diminished advertising spend or demand. For the DET, optimistic growth is fueled by broader academic adoption, allowing for price elevation, while the pessimistic view forecasts limited growth due to competition from established language tests, affecting test taker volume and pricing leverage. The following chart summarizes the results of the scenario-based intrinsic valuations. However, please note that the final valuation summary follows the CCA and CTA at the end of this paper.

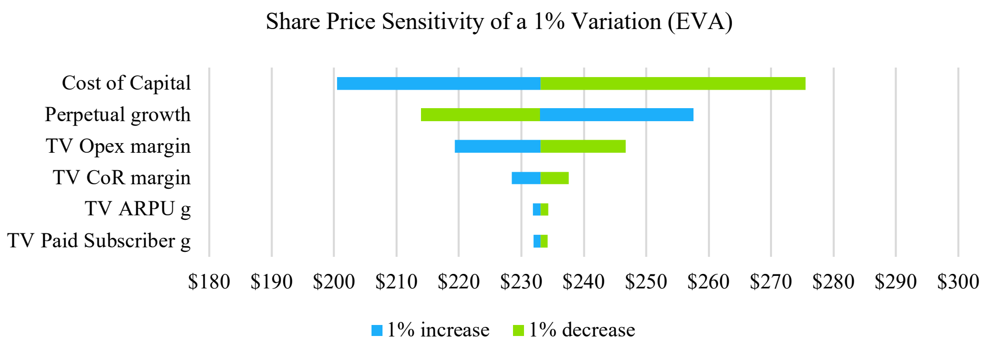
Figure 22: Range of implied share prices of Duolingo Inc. according to intrinsic valuation methods (created by the author)



The implied share prices are susceptible to changes in the cost of capital and terminal growth rate, as well as to changes in the terminal values of paid subscriber growth, average revenue per user growth, ad revenue per DAU growth, IAP revenue per DAU growth, DET price change and test taker growth on the revenue side, and to cost of revenue and operating expense margins on the cost side. The summary below shows the impact of a 1% change in the variables with the greatest impact on the implied share price of Duolingo, and the detailed results of the analysis of the impact of variations in all metrics on the implied share prices is provided in the appendix (see Tables 12 and 13 in the appendix).

Figure 23: Summary of sensitivity and impact analysis results (created by the author)





4.3. RELATIVE VALUATION – CCA & CTA

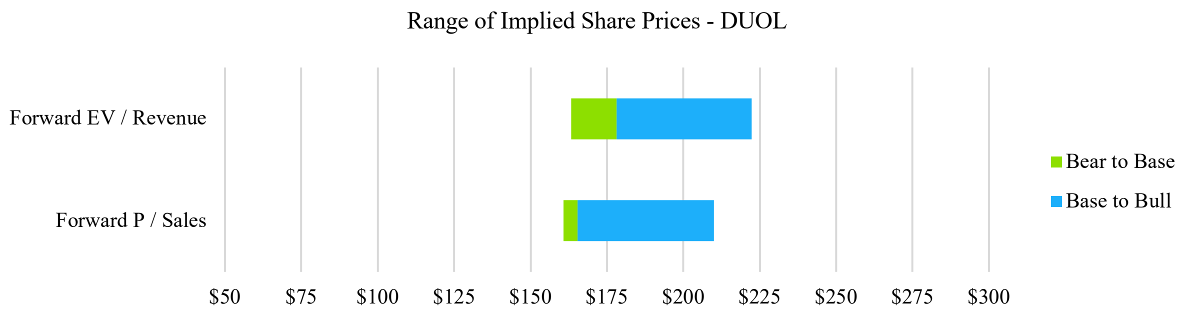
4.3.1. Comparable Company Analysis (Trading Comparables)

In relative valuation, the goal is to assess the worth of assets by comparing them to the market pricing of comparable assets. This approach involves multiples, which are prone to incorrect applications despite being straightforward and user-friendly. Relative valuation involves two main steps. Firstly, it necessitates identifying comparable companies, a challenging task given the uniqueness of each firm and variations in aspects like risk, growth prospects, and cash flows among companies in the same industry. Secondly, it requires standardizing prices into multiples, typically based on earnings, book values, or sales (Damodaran, 2023). The very aspects that make relative valuation advantageous are also its pitfalls. Its simplicity in assembling, through the selection of multiples and comparable companies, can lead to value estimates that overlook critical factors such as growth. Since multiples mirror market sentiment, employing them in company valuation might yield inflated values in an overvalued market or undervalued ones in a market that undervalues comparable firms. Thirdly, although bias can infiltrate any valuation method, the opaqueness surrounding the assumptions in relative valuations makes them especially susceptible to manipulation. An analyst with biases, given the freedom to select both the valuation multiple and the comparable firms, can manipulate the process to support almost any desired valuation outcome (Damodaran, 2023).

Identifying comparables for Duolingo is challenging due to its distinct position within the edtech sector, characterized by a unique gamification approach to language learning, significant growth, diverse revenue sources, and advanced AI-driven personalization. These attributes necessitate categorizing peers into five groups: non-subscription and subscription software edtech firms, mobile gaming and entertainment companies, generative AI companies, and large-cap tech companies (see Table 14 in the appendix). Fifteen valuation multiples were calculated, including nine enterprise and six equity multiples. Non-subscription software edtech and most mobile gaming entities were excluded to align the peer group more closely with Duolingo's growth trajectory (see Table 15 in the appendix). Duolingo’s final peer group contains the following companies: Powerschool Holdings, Instructure and Kahoot as edtech peers, Roblox Corporation as a mobile gaming and entertainment software peer, HubSpot, Shopify and Braze as software and AI peers, and finally, Adobe and Microsoft as large cap technology peers. For a detailed comparative peer analysis, please refer to Figures 31 to 34 in the appendix. The equity betas of Duolingo's industry peers are derived from an analysis of their five-year weekly returns using the MSCI World Index as a market return proxy, detailed in the beta regression figures located in the appendix (see Figure 30); following this, the betas were unlevered employing Hamada's equation, as previously discussed, to obtain their unadjusted asset betas, revealing that Duolingo's unadjusted asset beta of 1.24 lies between the median asset beta of 1.09 and the average asset beta of 1.41 of the final peer group. A comparison of the final peers' projected revenue growth for 2024 (Bloomberg, 2023), asset betas and revenue multiples can be found in the appendix.

Due to Duolingo's high trading multiples relative to EBITDA, EBIT, and net income, the analysis disregards multiples based on these metrics for a more accurate valuation. The final valuation employs the Enterprise Value to Revenue (EV/Revenue) and Price to Sales (Price/Sales) multiples, anchored on three distinct temporal benchmarks: Last Twelve Months (LTM) values and forward-looking projections for the years 2023 and 2024. The results reveal a clear market position for Duolingo: it is currently trading at higher multiples than its peers.

Figure 24: CCA final valuation results (created by the author)



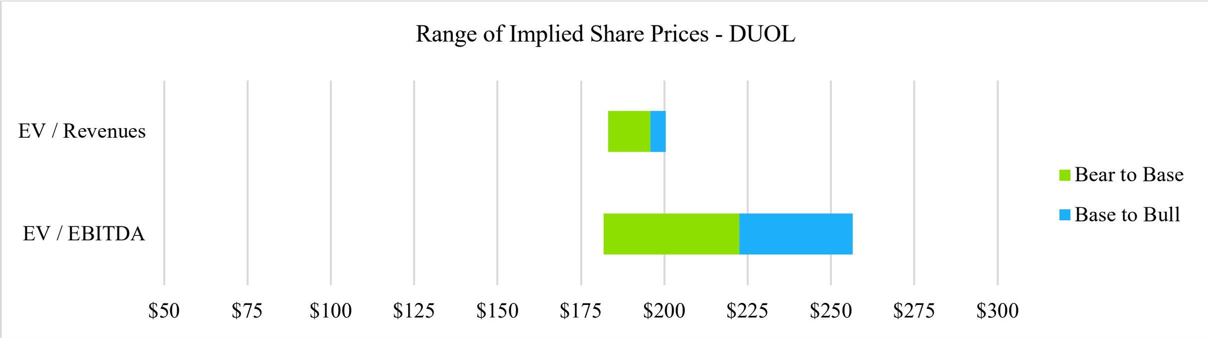
In the CCA, the employed methodology dictates that the base case reflects the 75th percentile of these multiples multiple observed in the final peer group, the bear case corresponds to the median of these multiples, and the bull case aligns with the maximum multiple observed; consequently, this yields implied share prices for Duolingo ranging from $163.2 to $222.4 according to the forward enterprise value over revenue multiple, and from $160.7 to $210.1 based on the forward price over sales multiple.

4.3.2. Comparable Transaction Analysis (Transaction Comparables)

Like trading comparables, transaction comparables provide a market-based perspective on valuation. Aswath Damodaran defines CTA as a valuation method that analyzes prices paid for similar companies in recent acquisitions or mergers to estimate a company's value. Valuation multiples are derived by examining the transaction prices of these comparable firms. These multiples are then applied to the company under valuation. Damodaran underscores the importance of selecting appropriate comparables and adjusting for differences while also considering the market conditions during the comparables' transactions versus the current market situation. This method offers a market-based perspective but assumes that past transactions can reliably indicate future values, an assumption that may not always be accurate (Damodaran, 2010).

In this paper, adjustments for control premiums in comparable M&A transactions are not incorporated, primarily due to insufficient data to quantify these premiums accurately. Accordingly, adjustments for underpricing in IPOs are not implemented either. Six IPOs and five M&A transactions, including buyouts, within the educational software and entertainment software sectors were analyzed, most of which occurred post-2020 (see Table 16 in the appendix). In the final transaction comparables analysis, only two transaction multiples were employed: EV/Revenues and EV/EBITDA. EBIT and net income multiples were excluded due to their lack of yielding valuable insights. The final results of the CTA are displayed in the Figure 25 below.

Figure 25: CTA final valuation results (created by the author)



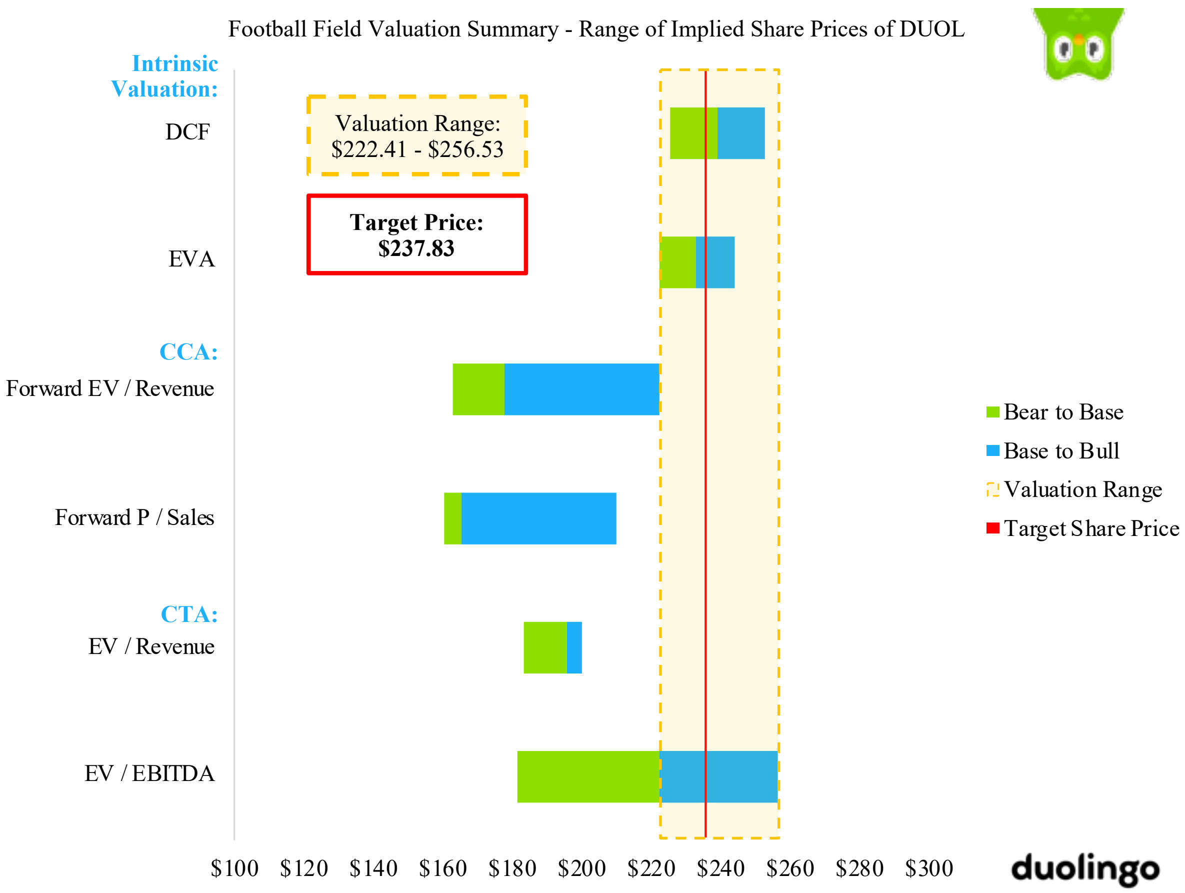
In the CTA methodology employed, the base case is aligned with the average multiple from observed transactions in the group, the bear case corresponds to the median multiple, and the bull case aligns with the 75th percentile of the observed multiples; consequently, this results in the implied share prices of Duolingo falling within a range of $183.2 to $200.4 based on the enterprise value over revenue multiple, and within a range of $181.8 to $256.5 when calculated using the enterprise value over EBITDA multiple.

The relative valuation yields relatively large valuation ranges compared to the intrinsic valuation performed earlier. It also suggests that Duolingo is trading at higher multiples than its peers; however, the intrinsic valuation indicates a significantly higher share price than the relative valuation.

5. Conclusion & Recommendation

A comprehensive approach was employed to determine Duolingo's target share price, centering on DCF variations to estimate intrinsic values under different scenarios and on relative valuation methods. The final valuation results can be found in the football field chart below.

Figure 26: Final valuation summary (created by the author)



The final valuation range for Duolingo is established between $222.41, derived from the upper bound of the forward EV/Revenue multiple from trading comparables, and $256.63, originating from the upper limit of the EV/EBITDA multiple of transaction comparables. This range is predicated on the assumption that Duolingo will maintain trading multiples surpassing its peers even in a bear-case scenario. In a bull case, it will trade at the apex of the transaction EV/EBITDA multiple encompassed within the CTA valuation spectrum. The conclusive target share price is determined by assigning comprehensive weights to each valuation methodology and specific weights to individual scenarios or multiples within these methodologies. Within the intrinsic valuation framework, weights of 50%, 10%, and 40% are allocated to the base, bear, and bull cases, signifying a higher likelihood of Duolingo's growth exceeding the base case projections compared to underperformance. In the CCA, the EV/Revenue multiple is accorded a 60% weight, whereas the Price/Sales multiple receives a 40% weight due to its relatively lower alignment with the valuation range. Similarly, in the CTA, the EV/EBITDA multiple is prioritized with a 60% weight, while the EV/Revenue multiple is assigned a 40% weight for analogous reasoning. Predominantly, the Discounted Cash Flow (DCF) methodology is attributed a 90% weight, reflecting Duolingo's intrinsic value and anticipated to mirror the company's true worth more accurately in this growth scenario. Both the CCA and CTA are allocated a minimal weight of 5% each, underscoring the market's apparent undervaluation of Duolingo and thereby relegating their influence in the final investment recommendation. Consequently, this culminates in a target share price for Duolingo of $237.83. Comparing this target price to the share price as of information cut-off date, November 9th, 2023, after the announcement of Duolingo’s third quarter results, indicates a 17.5% premium. Therefore, this paper suggests a “BUY” recommendation to existing equity investors and new investors who wish to participate in Duolingo’s equity growth story.

The relative valuation methodology suggests an overvaluation of Duolingo compared to the peer group. However, this perspective is nuanced by the inherent challenge of identifying appropriate Duolingo peers. The company's distinctive blend of characteristics—spanning the educational technology space, a freemium B2C subscription and B2B software-as-a-service business model, diversified revenue streams, a gamified learning approach, extensive utilization of artificial intelligence in its platform, strong brand recognition, and unmatched historical and projected revenue growth—sets it markedly apart from its peers, especially in the edtech space, consequently justifying its higher valuation metrics.

The valuation of high-growth technology firms, such as Duolingo, using traditional methodologies presents limitations. The application of DCF analysis encounters complexities due to the significant temporal distance of these firms from achieving stable growth, complicating the forecasting of growth revenue and free cash flow growth. Additionally, in relative valuation, selecting appropriate multiples is constrained, given that such companies often exhibit positive top-line growth coupled with negative EBITDA or EBIT, mirroring the financial profiles of their limited peer group. This uniqueness restricts peer comparison and fuels ongoing debates among practitioners and academics regarding the advisability of employing multiples in such contexts (Hennessy, 2017). These challenges underscore the necessity for a nuanced approach to valuing firms with distinctive growth trajectories and financial characteristics.

6. Valuation of High-Growth Tech Firms – A Short Literature Review

6.1. High-growth tech companies

High-growth tech companies are defined through various lenses, reflecting their unique characteristics in the technology sector. They are characterized by their innovative approaches (Malecki, 1984), rapid growth (Jacobs & Everett, 1988), involvement in high-tech industries (Jiang, 2020), and their significant role in creating economic benefits and quality jobs (Good, 1996). They are typically knowledge-intensive, skill-intensive, and face unique challenges and uncertainties in their operation and development (Wang Yu-cui & Jia Xiuyan, 2012). A more insightful approach than relying on standard textbook definitions involves recognizing enterprises that substantially drive economic expansion. This refers to high-growth businesses, characterized as those experiencing an average annualized increase in growth rate of at least 20% p.a. over three years (Yap, 2022).

6.2. Importance of valuation of high-growth tech companies

The valuation of high-growth tech companies holds significant importance for various stakeholders, as evidenced by numerous studies and research papers. Gatti (2004) highlights the significance of valuation for venture capitalists to assess risk and potential return on their investments in high-growth tech companies, while Caselli (2010) states that valuation is crucial in negotiations, particularly for determining the amount of capital needed and the proportion of shares given to venture capitalists in high-risk, high-tech companies. Zhou and Wu (2015) emphasize the role of valuation in aiding investors in understanding the financial performance of high-growth, high-tech firms and making appropriate investment choices. Kettell (2002) discusses how valuation helps investors comprehend the relationship between companies experiencing high losses and rapidly increasing stock prices. Van de Schootbrugge and Wong (2013) assert the importance of valuation in making critical decisions such as funding, selling, or buying shares and setting prices in mergers and acquisitions for early-stage high-tech development projects or companies.

6.3. FIRM VALUATION – DCF, CCA & CTA

In this paper, the valuation of Duolingo is conducted using the most taught techniques in corporate finance classes at university and those most frequently employed in practice by investment banks and M&A advisory firms: the Discounted Cash Flow (DCF) method, Comparable Company Analysis (CCA), and Comparable Transaction Analysis (CTA), also known under trading and transaction comparables (Corporate Finance Institute, 2023). DCF assumes that the value of a firm or asset is the present value of its expected future cash flows (Kumar, 2016). It involves estimating cash flows, setting a target debt ratio, and using the Weighted Average Cost of Capital (WACC) to discount them. The present value of the firm's equity is then determined by subtracting the current value of debt from the discounted cash flows (Larkin, 2011). It is used to judge the risk and uncertainty associated with a project or business, integrating risk assessment and future financial prospects into the valuation process (Uzma, Singh, & Kumar, 2010). CCA involves examining the ratios of similar publicly traded entities to estimate the value of another business. Unlike a discounted cash flow analysis that determines value based on intrinsic factors, the CCA is a relative valuation technique relying on external comparisons (Corporate Finance Institute, 2023). CTA is a valuation technique in which historical M&A transactions or IPO data are utilized to appraise a similar company's current value (Corporate Finance Institute, 2023).

6.4. LIMITATIONS OF DCF, CCA AND CTA FOR HIGH-GROWTH TECH FIRMS

The DCF method is prone to extreme sensitivity to key variables. This extreme sensitivity can lead to significant variations in valuation outcomes. Vayas-Ortega et al. (2020) find that cost of capital and free cash flow forecasting does not align with market expectations over time, across different sectors, or in various market regions when relying solely on historical and endogenous variables. The most accurate estimations are achieved by incorporating exogenous variables and employing data-driven linear methodologies. Furthermore, the accuracy of the DCF model depends not only on correctly forecasting future cash flows but also on estimating their growth rate in perpetuity. This can be particularly challenging for high-growth tech firms, where future cash flows can be highly unpredictable and volatile (Muller & Ward, 2016). Imam, Barker, and Clubb (2008) discuss the perceived limitations in the technical applicability of the model, leading analysts to rely more on valuation multiples and subjective judgment of market prices. This reliance indicates a lack of confidence in DCF for complex, high-growth environments.

Bowman and Bush (2007) note that CCA provides a reasonably accurate beta estimate when comparable companies are similar in size. However, significant downward bias can occur when larger companies are used for comparison, which can misrepresent the actual value of high-growth firms. Eaton, Guo, Liu, and Officer (2021) highlight challenges in selecting peers in CCA, which can be problematic for high-growth firms with unique characteristics. Meitner (2003) suggests that traditional single-factor comparable company valuation methods using standalone multiples, such as the price-earnings ratio, come with notable limitations. The two primary issues include the inability to apply negative values in the reference base and the high requirements for the qualitative characteristics of comparable companies. Cragg and Malkiel (1968) point out that high growth expectations lead to high valuations and high valuation multiples for some companies, while peers are valued lower due to lower growth expectations in the market. This discrepancy creates challenges in finding truly comparable companies for an accurate CCA. The CTA shares certain limitations with the CCA when it comes to valuing high-growth tech firms, including difficulties in accurately selecting comparable transactions and the occurrence of negative numbers in the denominator for some transaction multiples.

In summary, while the DCF method is a foundational tool in valuation, its application to high-growth tech firms is fraught with challenges such as sensitivity to variable inputs, difficulties forecasting future cash flows, and perceived technical limitations. While CCA is commonly used, its application to high-growth firms is limited by assumptions related to endogenous factors, biases when using larger comparable companies, challenges in accurately selecting related firms, and the drawbacks of using single-factor models. The literature also reveals that CCA's effectiveness is limited by the market's differential growth expectations for high-growth companies compared to their peers. These expectations can lead to disparities in valuation, posing a challenge in finding comparable companies that reflect similar growth prospects.

APPENDIX A - REFERENCES

Alam, S.M. Ikhtiar. (2022). Cost of Capital: The Hamada Equation. 10.13140/RG.2.2.16956.72325.

André F. Perold. "The Capital Asset Pricing Model." Journal of Economic Perspectives, 18 (2004): 3-24. https://doi.org/10.1257/0895330042162340.

Bionducci, Luca, Alessio Botta, Philip Bruno, Olivier Denecker, Carolyne Gathinji, Reema Jain, Marie-Claude Nadeau, and Bharath Sattanathan. “On the Cusp of the next Payments Era: Future Opportunities for Banks.” McKinsey & Company, September 18, 2023. https://www.mckinsey.com/industries/financial-services/our-insights/the-2023-mckinsey-global-payments-report.

Sanako. “Technology in Language Teaching and Learning.” Sanako, September 26, 2023. https://sanako.com/technology-in-language-teaching-and-learning.

Bughin, Jacques, Jonathan Doogan, and Ole Jørgen Vetvik. “A New Way to Measure Word-of-Mouth Marketing.” McKinsey & Company, April 1, 2010. https://www.mckinsey.com/capabilities/growth-marketing-and-sales/our-insights/a-new-way-to-measure-word-of-mouth-marketing.

C. Muller and M. Ward. "The Implied Growth Rate in the Valuation of JSE Listed Companies." Corporate Finance: Valuation (2016). https://doi.org/10.2139/ssrn.2739677.

Can Working Capital Be Negative? Universal CPA Review. Accessed November 25, 2023. https://www.universalcpareview.com/ask-joey/can-working-capital-be-negative/.

Canessa, James L. and Jarrell, Gregg A.. "The Proper Treatment of Cash Holdings in DCF Valuation Theory and Practice" Journal of Business Valuation and Economic Loss Analysis 17, no. 1 (2022): 39-64. https://doi.org/10.1515/jbvela-2022-0009

Chen, James. “AAA: Definition as Credit Rating, Criteria, and Types of Bonds.” Investopedia. Accessed November 29, 2023. https://www.investopedia.com/terms/a/aaa.asp.

Christopher Hennessy, “5 Reasons Valuing Tech Firms Is Tough.” London Business School. Accessed December 6, 2023. https://www.london.edu/think/5-reasons-valuing-tech-firms-is-tough---5-ways-to-tackle-doing-it.

Comparable Company Analysis. Corporate Finance Institute, November 23, 2023. https://corporatefinanceinstitute.com/resources/valuation/comparable-company-analysis

Country Default Spreads and Risk Premiums. Welcome to Pages at the Stern School of Business, New York University. Accessed November 29, 2023. https://pages.stern.nyu.edu/~adamodar/New_Home_Page/datafile/ctryprem.html.

Davis, Joey. “The Success of Education Technology Post-Covid.” Avixa Portal, October 4, 2021.https://www.avixa.org/pro-av-trends/articles/the-success-of-education-technology-post-covid.

Duolingo - Funding, Financials, Valuation & Investors. Crunchbase. Accessed November 25, 2023. https://www.crunchbase.com/organization/duolingo/company_financials.

Duolingo competitors and Alternatives - Owler. Accessed October 17, 2023. https://www.owler.com/company/duolingo/competitors.

E. Eusébio, C. Camus and Carolina Curvelo. "Metaheuristic approach to the Holt-Winters optimal short term load forecast." Renewable energy & power quality journal, 13 (2015): 708-713. https://doi.org/10.24084/REPQJ13.460.

E. Malecki. "High Technology and Local Economic Development." Journal of The American Planning Association, 50 (1984): 262-269. https://doi.org/10.1080/01944368408976593.

F. Echterling and B. Eierle. "Mean reversion adjusted betas used in business valuation practice: a research note." Journal of Business Economics, 85 (2015): 759-792. https://doi.org/10.2139/SSRN.2317913.

Fernandez, Pablo. “Levered and Unlevered Beta.” IESE Research Papers, January 25, 2003. https://ideas.repec.org/p/ebg/iesewp/d-0488.html.

Form 10-K for Duolingo Inc filed 03/01/2023. Accessed October 6, 2023. https://investors.duolingo.com/static-files/06078a85-5de8-4c86-9a6a-7036259b07a4.

Free Language Exchange: Language Partners. HelloTalk. Accessed October 17, 2023. https://www.hellotalk.com/.

Free Online Courses, Lessons & Practice. Khan Academy. Accessed October 17, 2023. https://www.khanacademy.org/.

G. Erickson and B. Bayus. "R&D Productivity in the Personal Computer Industry." IO: Productivity (2001). https://doi.org/10.2139/ssrn.296228.

Germania Vayas-Ortega, C. Soguero-Ruíz, J. Rojo-álvarez and F. Gimeno-Blanes. "On the Differential Analysis of Enterprise Valuation Methods as a Guideline for Unlisted Companies Assessment (I): Empowering Discounted Cash Flow Valuation." Applied Sciences, 10 (2020): 5875. https://doi.org/10.3390/app10175875.

Good, M. (1996). Technology and Trade. Law and policy in international business, 27, 853. https://doi.org/10.4324/9780203015322-17.

GoodWhale – Investing Simplified. “Language Learning Made Free: The Fascinating Journey of Duolingo’s Founder, Luis von Ahn.” LinkedIn. Accessed October 6, 2023. https://www.linkedin.com/pulse/language-learning-made-free-fascinating-journey-duolingos.

Gordon, M. J. “Dividends, Earnings, and Stock Prices.” The Review of Economics and Statistics 41, no. 2 (1959): 99–105. https://doi.org/10.2307/1927792.

Gregory W. Eaton, Feng Guo, Tingting Liu and Micah S. Officer. "Peer Selection and Valuation in Mergers and Acquisitions." Econometric Modeling: Corporate Finance & Governance eJournal (2021). https://doi.org/10.2139/ssrn.3771664.

H. N. Higgins. "Forecasting stock price with the residual income model." Review of Quantitative Finance and Accounting, 36 (2011): 583-604. https://doi.org/10.1007/S11156-010-0187-Y.

Hoffelder, Kathy. “The Positives of Negative Working Capital.” CFO, June 8, 2012. https://www.cfo.com/news/the-positives-of-negative-working-capital/667200/.

Ignacio Vélez-Pareja. "Calculating Betas." EduRN: Management Education (MRN) (Topic) (2011). https://doi.org/10.2139/ssrn.1773489.

Ignacio Vélez-Pareja. "Construction of Consistent Forecasted Financial Statements (ConstruccióN De Estados Financieros Proyectados Y Consistentes)." Entrepreneurship Educator: Courses (2006). https://doi.org/10.2139/SSRN.895821.

J. G. Cragg and B. Malkiel. "THE CONSENSUS AND ACCURACY OF SOME PREDICTIONS OF THE GROWTH OF CORPORATE EARNINGS." Journal of Finance, 23 (1968): 67-84. https://doi.org/10.1111/J.1540-6261.1968.TB02998.X.

Jason Hall. "Comment on 'Regulation and the Term of the Risk Free Rate: Implications of Corporate Debt'." IO: Regulation (2007). https://doi.org/10.1108/10309610780000692.

Joseph Tham. "Constructing the Free Cash Flow (Fcf) with Retention of Surplus Funds: The No Tax Case." Accounting Educator: Courses (2003). https://doi.org/10.2139/SSRN.382602.

Kagan, Julia. “Tax Shield: Definition, Formula for Calculation, and Example.” Investopedia. Accessed November 29, 2023. https://www.investopedia.com/terms/t/taxshield.asp.

Kelley, Lauren. “SAAS G&A Expense Is Surprisingly High.” OPEXEngine, April 21, 2022. https://www.opexengine.com/saas-ga-expense-is-surprisingly-high/.

Learn a Language for Free. Duolingo. Accessed October 6, 2023. https://www.duolingo.com/.

Lease Accounting: Operating and Finance Leases and Valuation. Mergers & Inquisitions, November 22, 2023. https://mergersandinquisitions.com/lease-accounting/.

Looking to 2060: Long-term Global Growth Prospects - OECD. Accessed November 30, 2023. https://www.oecd.org/economy/lookingto2060long-termglobalgrowthprospects.htm.

Marc Schauten. "Tres métodos de descuento para valuar proyectos y la tasa requerida de rendimiento para el capital accionario." Contaduría y Administración, 58 (2013): 63-82. https://doi.org/10.1016/S0186-1042(13)71198-7.

Martin, Kevin. “Top 5 Edtech Trends for 2023: Cambridge.” World of Better Learning | Cambridge University Press, February 1, 2023. https://www.cambridge.org/elt/blog/2023/02/02/top-5-edtech-trends-for-2023/.

Mascarenhas, Natasha. “Duolingo Makes Its First Official Acquisition, with More to Come.” TechCrunch, October 4, 2022. https://techcrunch.com/2022/10/04/duolingo-makes-its-first-official-acquisition-with-more-to-come

Matthias Meitner. "Option-Style Multi-Factor Comparable Company Valuation for Practical Use." Corporate Finance: Valuation (2003). https://doi.org/10.2139/ssrn.485563.

Miles, J. A., & Ezzell, J. R. (1980). The Weighted Average Cost of Capital, Perfect Capital Markets, and Project Life: A Clarification. Journal of Financial and Quantitative Analysis, 15,719-730. https://doi.org/10.2307/2330405

Mingli Xu, Wei Yang, Lirang Pang and Dongmin Kong. "R&D, FINANCIAL CONSTRAINTS AND PRODUCTIVITY: EVIDENCE FROM THE CHINESE INDUSTRIAL ENTERPRISES." The Singapore Economic Review, 65 (2017): 947-967. https://doi.org/10.1142/S0217590817500126.

Modigliani, Franco, and Merton H. Miller. 1958. "The Cost of Capital, Corporation Finance and the Theory of Investment." *American Economic Review* 48 (3): 261–297. https://www.jstor.org/stable/1809766.

Multiples: First principles - new york university. Accessed December 1, 2023. https://pages.stern.nyu.edu/~adamodar/pdfiles/papers/multiples.pdf.

P. Larkin. "To Iterate Or Not To Iterate? Using The WACC In Equity Valuation." Journal of Business & Economics Research, 9 (2011): 29-34. https://doi.org/10.19030/JBER.V9I11.6497.

Powerful, Intelligent Flashcards. Anki. Accessed October 17, 2023. https://apps.ankiweb.net/.

Precedent Transaction Analysis. Corporate Finance Institute, June 16, 2023. https://corporatefinanceinstitute.com/resources/valuation/precedent-transaction-analysis/.

Published by Laura Ceci. “Top Language Learning Apps Monthly Downloads 2023.” Statista, October 17, 2023. https://www.statista.com/statistics/1282766/language-learning-apps-monthly-downloads/.

R. Bowman and S. Bush. "Using Comparable Companies to Estimate the Betas of Private Companies." Financial Accounting (2007).

R. Hayen. "How to design a financial planning model.." Long range planning, 16 5 (1983): 111-22. https://doi.org/10.1016/0024-6301(83)90086-9.

R. Jacobs and J. Everett. "THE IMPORTANCE OF TEAM BUILDING IN A HIGH-TECH ENVIRONMENT." Journal of European Industrial Training, 12 (1988): 10-15. https://doi.org/10.1108/EB002250.

R. Jiang. "Analysis of the Impact of Venture Capital on the Overall Level of Technological Innovation in High-tech Enterprises." 2020 Conference on Economics and Management (CEAM2020) (2020). https://doi.org/10.38007/proceedings.0000532.

Rajesh Kumar. "Discounted cash flow valuation models." (2016): 145-185. https://doi.org/10.1016/B978-0-12-802303-7.00006-1.

Rajesh Kumar. "Estimation of cost of capital." (2016): 93-118. https://doi.org/10.1016/B978-0-12-802303-7.00004-8.

ReportLinker. "The EdTech Market Size Was Valued at USD 254.80 Billion in 2021 and Is Expected to Reach USD 605.40 Billion by 2027." GlobeNewswire News Room, January 25, 2022. https://www.globenewswire.com/news-release/2022/01/25/2372765/0/en/The-EdTech-market-size-was-valued-at-USD-254-80-billion-in-2021-and-is-expected-to-reach-USD-605-40-billion-by-2027.html.

RileyCNBC. "Duolingo Closes up 36% in Nasdaq Debut, Valuing Company at Nearly $5 Billion." CNBC, July 28, 2021. https://www.cnbc.com/2021/07/28/language-learning-app-duolingo-pops-35percent-in-public-debut-on-the-nasdaq.html.

Rosetta Stone - Crunchbase Company Profile & Funding. Crunchbase. Accessed October 16, 2023. https://www.crunchbase.com/organization/rosetta-stone.

Sanghvi, Saurabh, and Marius Westhoff. "Five Trends to Watch in the Edtech Industry." McKinsey & Company, November 14, 2022. https://www.mckinsey.com/industries/education/our-insights/five-trends-to-watch-in-the-edtech-industry.

Selby, Jonathan. "Insurance & Risk Management for Edtech Companies." Founder Shield, August 12, 2023. https://foundershield.com/blog/insurance-edtech-companies/.

Shah, Sachin, Damian Stephenson, and Numan Waheed. "Reduce, Replace, Rethink: Transforming Technology Costs." Bain, October 17, 2022. https://www.bain.com/insights/reduce-replace-rethink-transforming-technology-costs/.

Shahed Imam, R. Barker and C. Clubb. "The Use of Valuation Models by UK Investment Analysts." European Accounting Review, 17 (2008): 503 - 535. https://doi.org/10.1080/09638180802016650.

Shigufta Hena Uzma, J. Singh and Naveen Kumar. "Discounted Cash Flow and Its Implication on Intangible Valuation." Global Business Review, 11 (2010): 365 - 377. https://doi.org/10.1177/097215091001100304.

Simplified, GoodWhale - Investing. "Language Learning Made Free: The Fascinating Journey of Duolingo's Founder, Luis von Ahn." LinkedIn. Accessed October 6, 2023.

https://www.linkedin.com/pulse/language-learning-made-free-fascinating-journey-duolingos.

Tandempartner Online Finden: The #1 Language Exchange App. Tandem. Accessed October 17, 2023. https://www.tandem.net/de.

Terminal Growth Rate. Corporate Finance Institute, June 16, 2023. https://corporatefinanceinstitute.com/resources/valuation/what-is-terminal-growth-rate/.

Tse, Crystal, and Katie Roof. "Education-Tech Company Udemy (UDMY) Falls in Debut after $421 Million IPO." Bloomberg.com, October 29, 2021. https://www.bloomberg.com/news/articles/2021-10-29/udemy-drops-as-much-as-10-in-debut-after-421-million-ipo#xj4y7vzkg.

Udemy Free Resource Center: Find Free Online Courses | Udemy. Accessed October 17, 2023. https://www.udemy.com/courses/free/.

Understanding Cash Flow Statements. CFA Institute. Accessed November 26, 2023. https://www.cfainstitute.org/en/membership/professional-development/refresher-readings/understanding-cash-flow-statements.

Wang Yu-cui and Jia Xiuyan. "Risk Evaluation of High and New Technology Start-Up Companies Based on Artificial Neural Network Evaluation Method." (2012): 1070-1073. https://doi.org/10.1109/ICEE.2012.570.

World Economic Outlook, October 2023: Navigating Global Divergences." IMF, October 10, 2023. https://www.imf.org/en/Publications/WEO/Issues/2023/10/10/world-economic-outlook-october-2023.

Yap, Audrey, Recognising High-Growth Technology Businesses (May 3, 2022). les Nouvelles - Journal of the Licensing Executives Society, Volume LVII No. 2, June 2022, Available at SSRN: https://ssrn.com/abstract=4099671

Yelenevych, Alex. "Council Post: The Future of EdTech." Forbes, December 27, 2022. https://www.forbes.com/sites/forbesbusinesscouncil/2022/12/26/the-future-of-edtech/?sh=41abb4856c2f.

APPENDIX B - FIGURES

Figure 27: Duolingo's relative historical stock price performance (Source: Bloomberg)

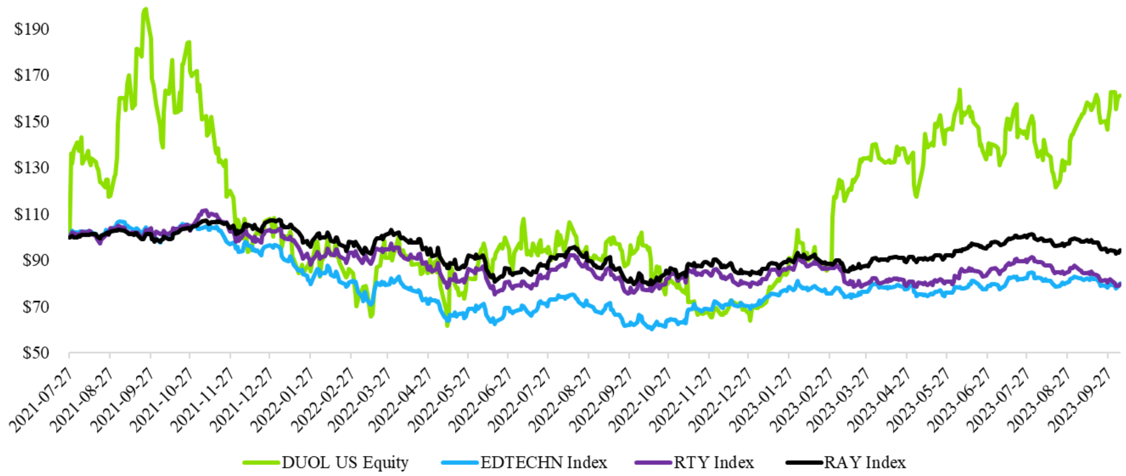


Figure 28: Duolingo's rolling annualized volatility (Source: Bloomberg)

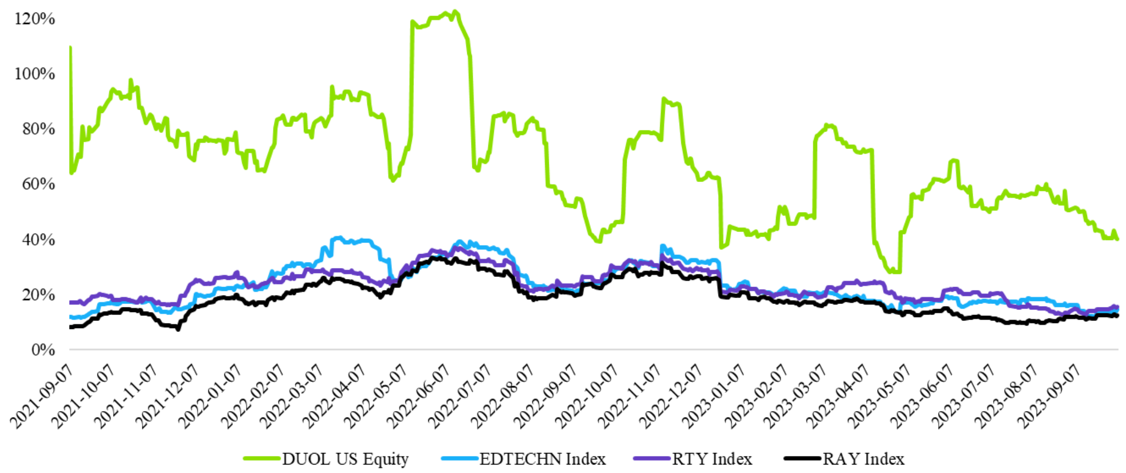


Figure 10: MAU forecast (in thousands) (created by the author)

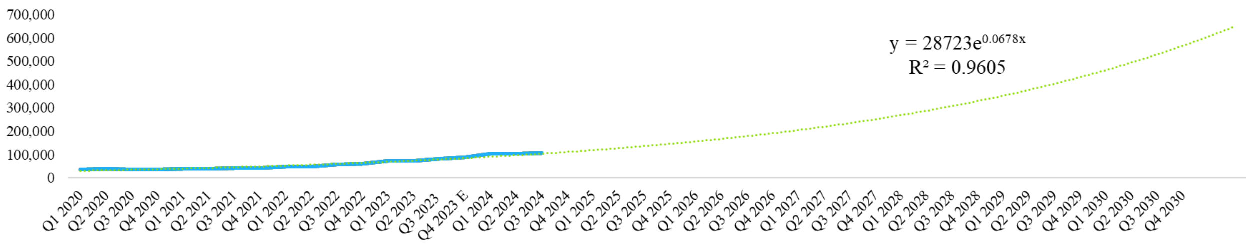


Figure 11: User engagement forecast (in %) (created by the author)

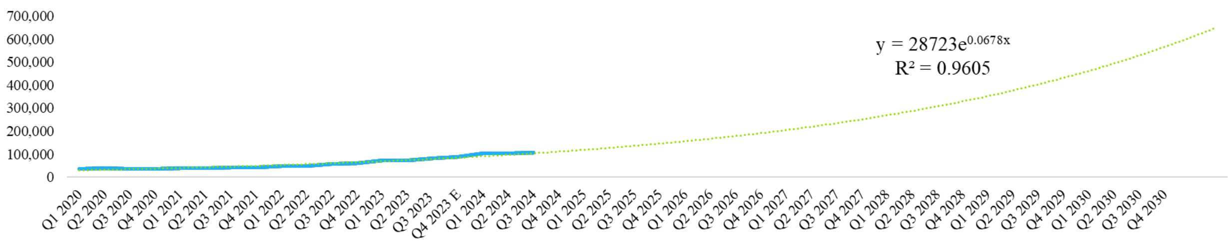


Figure 12: Conversion rate forecast (in %) (created by the author)

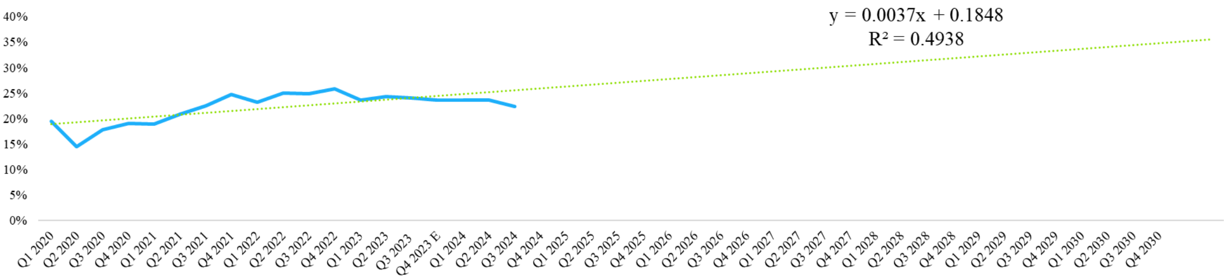
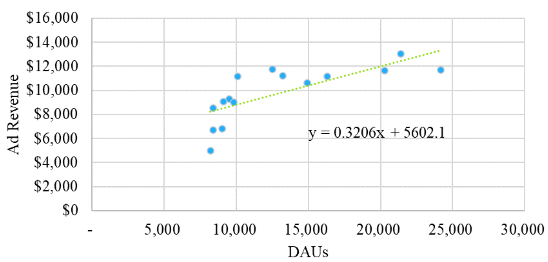


Figure 13: Advertising revenue regression (against DAUs, in thousands) & **Figure 14**: IAP revenue regression against DAUs (in thousands) (created by the author)



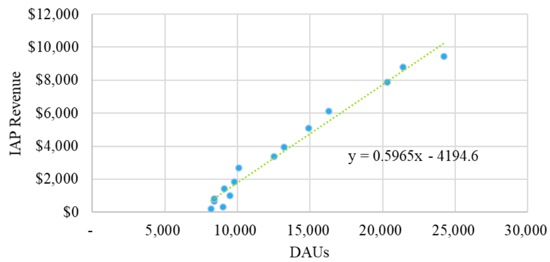


Figure 15: Forecast MAUs, DAUs and Paid Subscribers (in thousands) (created by the author)

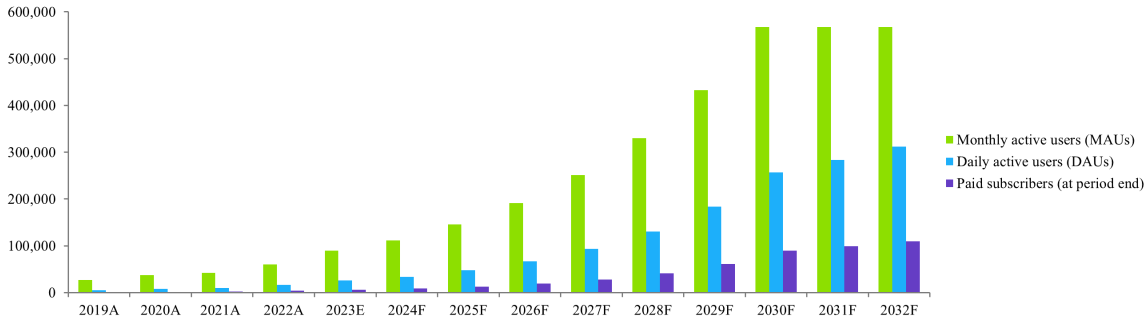


Figure 29: Forecast of Duolingo's cost in % of revenue (in thousands) (created by the author)

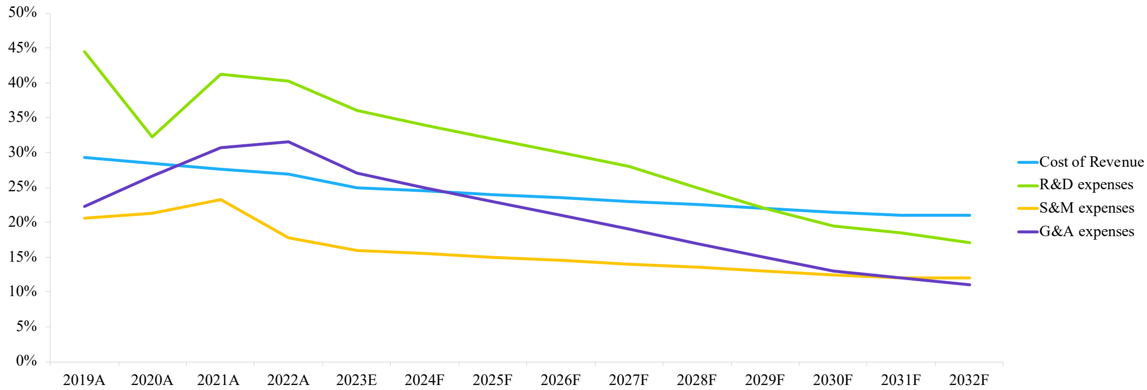


Figure 30: Beta regressions for Duolingo and its final peer group (created by the author)

Figure 31: Final peer group analysis (bubble size indicates asset beta size) (created by the author)

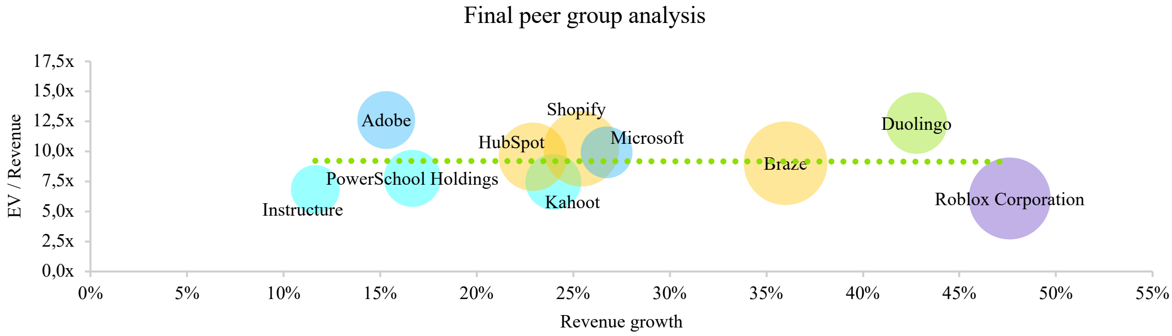


Figure 32: Final peer group revenue multiples (created by the author)

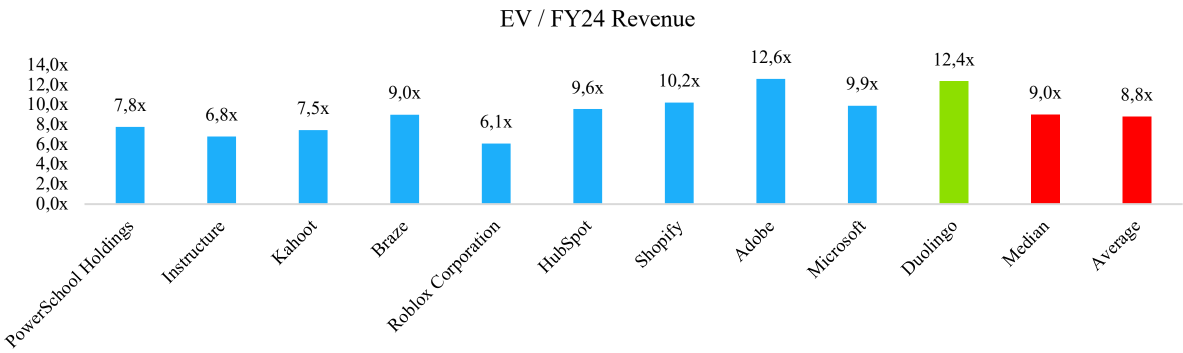


Figure 33: Final peer group revenue growth (created by the author)

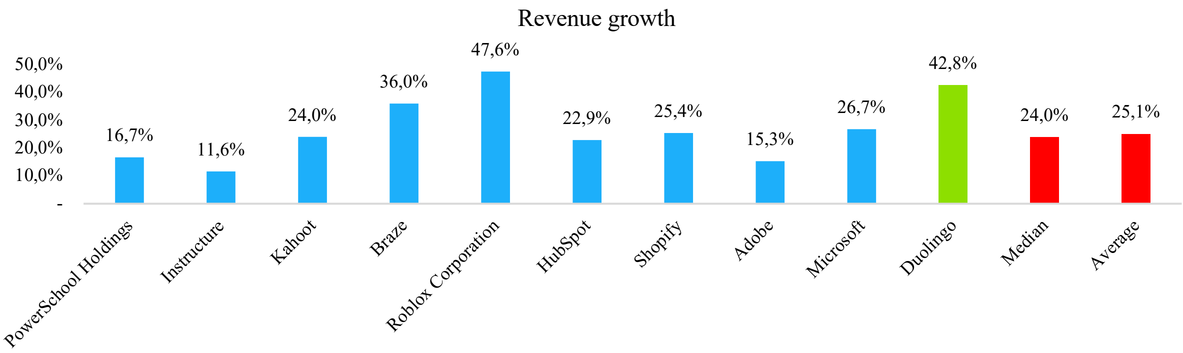


Figure 34: Final peer group asset betas (created by the author)

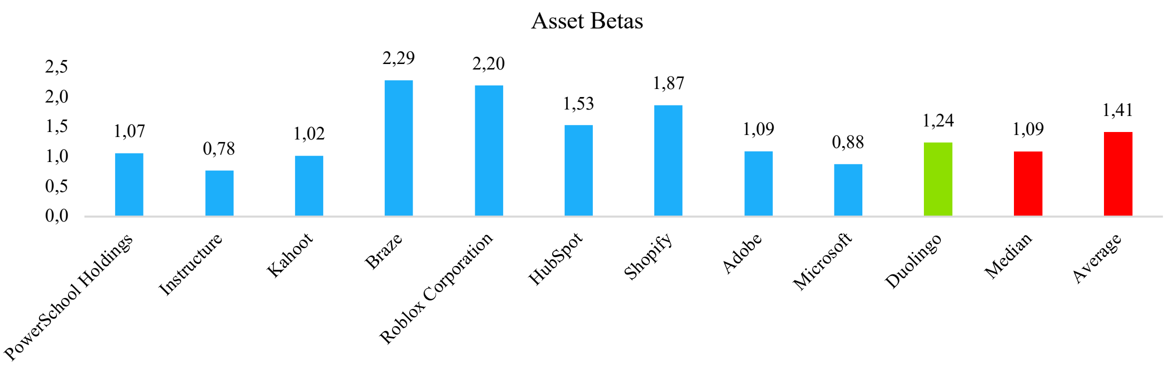
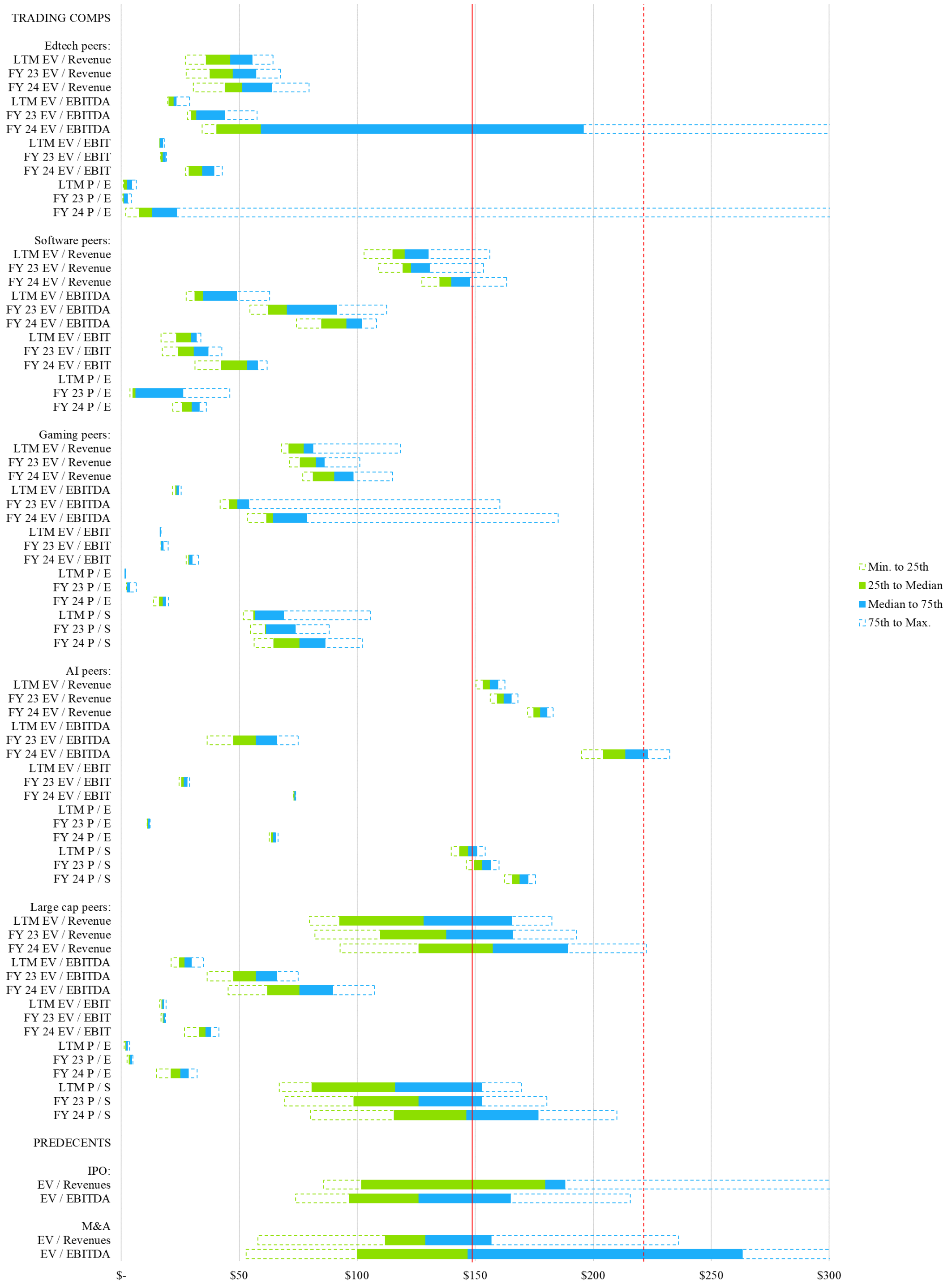


Figure 35: Range of implied share price of Duolingo, initial CCA & CTA (created by the author)



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[12] The red line represents Duolingo's share price as of valuation date (31st of October 2023) while the dashed red line represents Duolingo's share price upon creation of the graph (28th of November 2023).

APPENDIX C - TABLES

Table 1: Board of management of Duolingo as of October 2023 (Source: Duolingo)

Name	Function	Academic background
Luis von Ahn	Co-founder, CEO and Board Chairman	Ph.D. Computer Science from Carnegie Mellon University
Severin Hacker	Co-founder, CTO and Board Director	Ph.D. Computer Science from Carnegie Mellon University
Robert Meese	Chief Business Officer	MBA from MIT
Molly Lindsay	Chief People Officer	MBA from Stanford Graduate School of Business
Matthew Skaruppa	CFO	MBA from Stanford Graduate School of Business
Natalie Glance	Chief Engineering Officer	Ph. D. Physics drom Stanford Universitz
Stephen Chen	General Counsel	J.D. From Harvard University
Emmanuel Orssaud	Chief Marketing Officer	Master's degree in Digital Communication and Media

Table 2: Ownership table as of October 2023 (Source: Bloomberg)

Holder Name	Position	Institution Type	Country
Baillie Gifford & Co	4,275,077	Investment Advisor	United Kingdom
Durable Capital Partners LP	3,834,323	Venture Capital	United States
Vanguard Group Inc/The	3,068,930	Investment Advisor	United States
BlackRock Inc	2,323,082	Investment Advisor	United States
Whale Rock Capital Management LLC	1,328,760	Hedge Fund Manager	United States
Foxhaven Asset Management LP	1,157,209	Hedge Fund Manager	United States
Two Sigma Investments LP	1,025,569	Hedge Fund Manager	United States
NewView Capital Partners I LLC	1,000,000	Venture Capital	United States
Gilder Gagnon Howe & Co LLC	911,040	Brokerage	United States
T Rowe Price Group Inc	866,380	Investment Advisor	United States

Table 3: Holt-Winter's exponential smoothing short-term forecast parameters (created by the author)

	MAUs	*DAUs*	*Paid Subscribers*
alpha	0.39	0.66	0.24
beta	1.00	0.52	1.00
gamma	0.77	1.00	0.90

Table 4: Long-term trend forecasting parameters (created by the author)

	Trend	*R squared*
MAU	$y = 28723e^{0.0678x}$	0.9605
User Engagement Ratio	$y = 0.2183e^{0.0166x}$	0.8515
Conversion Rate	$y = 0.0037x + 0.1848$	0.4938

Table 6: Revenue stream CAGRs (created by the author)

	CAGRs		
	2019-2022	*2023-2030*	*2031-2032*
Subscription revenue	70.8%	31.8%	10.5%
Advertising revenue	46.9%	27.6%	5.0%
DET revenue	217%	23.6%	3%
In-app purchases	188.5%	51.9%	5%

Table 7: Duolingo's income statement forecast (in $ thousand)

Income Statement	2019A	2020A	2021A	2022A	2023E	2024F	2025F	2026F	2027F	2028F	2029F	2030F	2031F	2032F
Subscription Revenue	54,848.0	117,501.0	180,698.0	273,507.0	393,060.7	480,550.7	632,375.3	801,591.9	1,083,683.7	1,449,357.2	1,914,742.8	2,493,235.7	2,769,868.7	3,046,855.6
Advertising Revenue	14,118.0	27,043.0	38,501.0	44,731.0	50,443.7	61,701.8	76,359.0	98,024.6	128,390.6	170,950.9	230,602.7	314,209.3	329,919.8	346,340.1
Duolingo English Test Revenue	1,022.0	15,155.0	24,658.0	32,718.0	47,274.2	61,101.9	77,293.9	95,651.2	115,737.9	136,860.1	158,073.4	178,227.7	183,610.2	189,155.2
Other revenue (in-app purchases)	772.0	1,997.0	6,915.0	18,539.0	37,685.9	56,324.7	83,593.6	123,901.0	180,395.0	259,575.9	370,554.1	526,099.0	552,404.0	580,041.6
Total revenue	**70,760.0**	**161,696.0**	**250,772.0**	**369,495.0**	**528,464.4**	**659,679.0**	**869,621.8**	**1,119,168.6**	**1,508,207.2**	**2,016,744.1**	**2,673,972.9**	**3,511,771.7**	**3,835,802.7**	**4,162,392.6**
Cost of revenue (incl. D&A)	(20,737.0)	(45,987.0)	(69,186.0)	(99,431.0)	(132,116.1)	(161,621.4)	(208,709.2)	(263,004.6)	(346,887.7)	(453,767.4)	(588,274.0)	(755,030.9)	(805,518.6)	(874,102.4)
Gross Profit	**50,023.0**	**115,709.0**	**181,586.0**	**270,064.0**	**396,348.3**	**498,057.7**	**660,912.6**	**856,164.0**	**1,161,319.6**	**1,562,976.7**	**2,085,698.9**	**2,756,740.8**	**3,030,284.1**	**3,288,290.1**
Research & development	(31,494.0)	(52,050.0)	(103,573.0)	(148,944.0)	(190,247.2)	(224,290.9)	(278,279.0)	(335,750.6)	(422,298.0)	(504,186.0)	(588,274.0)	(684,795.5)	(709,623.5)	(711,769.1)
Sales & marketing	(14,590.0)	(34,437.0)	(58,445.0)	(65,895.0)	(84,554.3)	(102,250.2)	(130,443.3)	(162,279.4)	(211,149.0)	(272,260.5)	(347,616.5)	(438,971.5)	(460,296.3)	(499,487.1)
General & administrative	(15,776.0)	(43,063.0)	(76,849.0)	(116,420.0)	(142,685.4)	(164,919.8)	(200,013.0)	(235,025.4)	(286,559.4)	(342,846.5)	(401,095.9)	(456,530.3)	(460,296.3)	(462,025.6)
Total operating expenses (incl. D&A)	(61,860.0)	(129,550.0)	(238,867.0)	(331,259.0)	(417,486.9)	(491,460.9)	(608,735.3)	(733,055.4)	(920,006.4)	(1,119,293.0)	(1,336,986.5)	(1,580,297.3)	(1,630,216.1)	(1,673,281.8)
Earnings before interest, Taxes, D&A (EBITDA)	**(10,586.0)**	**(11,585.0)**	**(54,555.0)**	**(56,325.0)**	**(12,516.4)**	**17,780.7**	**65,877.6**	**139,852.7**	**261,418.6**	**468,085.6**	**778,179.0**	**1,211,503.9**	**1,440,872.4**	**1,661,048.2**
Depreciation & amortization	(1,251.0)	(2,256.0)	(2,726.0)	(4,870.0)	(8,622.2)	(11,183.9)	(13,700.3)	(16,744.1)	(20,105.4)	(24,401.9)	(29,466.6)	(35,060.3)	(40,804.4)	(46,039.9)
Operating profit from core activities	**(11,837.0)**	**(13,841.0)**	**(57,281.0)**	**(61,195.0)**	**(21,138.6)**	**6,596.8**	**52,177.3**	**123,108.5**	**241,313.2**	**443,683.7**	**748,712.4**	**1,176,443.5**	**1,400,068.0**	**1,615,008.3**
Other non-operating income (loss)	571.0	72.0	30.0	(676.0)	-	-	-	-	-	-	-	-	-	-
Earnings before Interest and Taxes (EBIT)	**(11,266.0)**	**(13,769.0)**	**(57,251.0)**	**(61,871.0)**	**(21,138.6)**	**6,596.8**	**52,177.3**	**123,108.5**	**241,313.2**	**443,683.7**	**748,712.4**	**1,176,443.5**	**1,400,068.0**	**1,615,008.3**
Interest expense	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Interest income	-	231.0	19.0	7,235.0	-	-	-	-	-	-	-	-	-	-
Abnormal losses	(1,228.0)	-	-	-	-	-	-	-	-	-	-	-	-	-
Earnings before Taxes (EBT)	**(12,494.0)**	**(13,538.0)**	**(57,232.0)**	**(54,636.0)**	**(21,138.6)**	**6,596.8**	**52,177.3**	**123,108.5**	**241,313.2**	**443,683.7**	**748,712.4**	**1,176,443.5**	**1,400,068.0**	**1,615,008.3**
Income tax expense	-	(68.0)	(177.0)	(938.0)	(634.2)	-	(7,304.8)	(22,159.5)	(50,675.8)	(93,173.6)	(157,229.6)	(247,053.1)	(294,014.3)	(339,151.7)
Net income (loss) and comprehensive income (loss)	**(12,494.0)**	**(13,606.0)**	**(57,409.0)**	**(55,574.0)**	**(21,772.7)**	**6,596.8**	**44,872.5**	**100,949.0**	**190,637.4**	**350,510.1**	**591,482.8**	**929,390.4**	**1,106,053.7**	**1,275,856.6**

Table 8: Duolingo's balance sheet forecast (in $ thousand)

Balance Sheet	2019A	2020A	2021A	2022A	2023E	2024F	2025F	2026F	2027F	2028F	2029F	2030F	2031F	2032F
Assets														
Current assets														
Cash and cash equivalents	59,843.0	120,490.0	553,922.0	608,180.0	662,733.4	787,341.4	978,547.4	1,236,115.4	1,602,653.6	2,161,978.0	2,990,407.8	4,178,729.9	5,427,481.1	6,820,195.1
Accounts receivable	10,005.0	20,450.0	33,163.0	46,728.0	93,912.0	116,453.6	154,056.3	196,480.9	266,557.1	356,434.8	472,073.4	619,990.8	677,197.3	734,855.6
Deferred cost of revenues	6,932.0	13,585.0	24,219.0	35,041.0	49,331.3	60,818.5	81,952.1	104,814.6	140,804.4	188,280.8	249,644.6	328,681.7	359,009.1	389,576.1
Income tax receivable	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Prepaid expenses and other current assets	2,143.0	3,855.0	7,967.0	7,234.0	13,934.9	16,748.9	22,415.8	27,171.3	38,388.7	51,332.5	67,571.5	88,658.9	96,432.7	105,360.8
Total current assets	**78,923.0**	**158,380.0**	**619,271.0**	**697,183.0**	**819,911.5**	**981,362.4**	**1,236,971.6**	**1,564,582.3**	**2,048,403.8**	**2,758,026.1**	**3,779,697.2**	**5,216,061.4**	**6,560,120.2**	**8,049,987.6**
Non current assets														
Property and equipment, net	4,676.0	6,428.0	8,211.0	12,969.0	16,097.4	19,215.9	23,026.8	27,246.1	32,665.5	39,113.4	46,360.4	54,056.0	60,417.2	65,924.4
Goodwill	-	-	-	4,050.0	4,050.0	4,050.0	4,050.0	4,050.0	4,050.0	4,050.0	4,050.0	4,050.0	4,050.0	4,050.0
Intangible assets, net	1,791.0	2,296.0	4,566.0	8,497.0	11,014.9	13,204.5	15,694.6	18,233.7	21,364.9	24,799.6	28,195.7	31,092.8	33,792.6	36,356.6
Operating lease right-of-use assets	9,145.0	8,073.0	28,369.0	22,508.0	46,664.6	51,499.7	74,007.5	87,403.9	124,265.1	163,185.2	218,268.4	283,603.7	312,323.3	337,906.6
Deferred tax assets	-	-	-	633.0	-	-	-	-	-	-	-	-	-	-
Other assets	524.0	562.0	894.0	1,507.0	2,447.4	2,597.5	3,524.6	4,672.6	6,333.3	8,468.7	10,997.6	14,566.4	15,983.2	17,337.2
Total non-current assets	**16,136.0**	**17,359.0**	**42,040.0**	**50,164.0**	**80,274.3**	**90,567.7**	**120,303.5**	**141,606.4**	**188,678.7**	**239,617.0**	**307,872.1**	**387,368.8**	**426,566.3**	**461,574.7**
Total assets	**95,059.0**	**175,739.0**	**661,311.0**	**747,347.0**	**900,185.9**	**1,071,930.1**	**1,357,275.1**	**1,706,188.7**	**2,237,082.5**	**2,997,643.1**	**4,087,569.3**	**5,603,430.2**	**6,986,686.6**	**8,511,562.3**
Liabilities, convertible preferred stock and stockholder's equity														
Current liabilities														
Accounts payable	3,811.0	2,196.0	7,818.0	1,177.0	11,770.5	10,573.3	14,575.7	15,529.6	24,576.7	32,149.0	39,532.3	51,007.3	54,418.1	59,051.4
Deferred revenues	26,307.0	54,792.0	98,267.0	157,550.0	201,990.5	253,866.0	344,654.0	444,806.1	588,511.5	786,945.6	1,047,670.2	1,380,817.7	1,508,225.6	1,636,639.7
Income tax payable	-	68.0	113.0	1,069.0	-	-	-	-	-	-	-	-	-	-
Accrued expenses and other current liabilities	1,989.0	8,634.0	12,933.0	21,970.0	25,437.4	35,055.9	46,156.8	59,822.8	78,353.3	104,772.4	140,957.5	184,822.4	201,876.0	219,064.2
Total current liabilities	**32,107.0**	**65,690.0**	**119,131.0**	**181,766.0**	**239,198.4**	**299,495.2**	**405,386.5**	**520,158.5**	**691,441.4**	**923,867.0**	**1,228,160.0**	**1,616,647.4**	**1,764,519.7**	**1,914,755.3**
Non-current liabilities														
Long-term obligation under operating leases	9,242.0	8,131.0	29,124.0	23,503.0	47,646.6	52,806.0	76,082.0	89,898.8	127,452.4	167,575.7	224,221.4	291,281.9	318,158.5	345,247.3
Long-term financial debt	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total non-current liabilities	**9,242.0**	**8,131.0**	**29,124.0**	**23,503.0**	**47,646.6**	**52,806.0**	**76,082.0**	**89,898.8**	**127,452.4**	**167,575.7**	**224,221.4**	**291,281.9**	**318,158.5**	**345,247.3**
Total liabilities	**41,349.0**	**73,821.0**	**148,255.0**	**205,269.0**	**286,845.0**	**352,301.2**	**481,468.5**	**610,057.3**	**818,893.8**	**1,091,442.7**	**1,452,381.4**	**1,907,929.3**	**2,082,678.1**	**2,260,002.6**
Stockholders' equity														
Common stock	1.0	1.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Additional paid-in capital	148,712.0	212,696.0	683,966.0	772,562.0	865,597.6	965,288.9	1,076,594.1	1,195,969.9	1,327,389.8	1,464,891.3	1,602,396.1	1,733,318.6	1,835,772.4	1,907,467.2
Accumulated deficit	(95,003.0)	(110,779.0)	(170,914.0)	(230,488.0)	(252,260.7)	(245,663.9)	(200,791.5)	(99,842.4)	90,794.9	441,305.1	1,032,787.9	1,962,178.3	3,068,232.0	4,344,088.5
Total stockholders' equity	**53,710.0**	**101,918.0**	**513,056.0**	**542,078.0**	**613,340.9**	**719,628.9**	**875,806.7**	**1,096,131.4**	**1,418,188.7**	**1,906,200.4**	**2,635,188.0**	**3,695,500.9**	**4,904,008.4**	**6,251,559.7**
Total liabilities, convertible preferred stock and stockholder's equity	**95,059.0**	**175,739.0**	**661,311.0**	**747,347.0**	**900,185.9**	**1,071,930.1**	**1,357,275.1**	**1,706,188.7**	**2,237,082.5**	**2,997,643.1**	**4,087,569.3**	**5,603,430.2**	**6,986,686.6**	**8,511,562.3**
					-	-	-	-	-	-	-	-	-	-
Balance check	*OK*	*OK*	*OK*	*OK*	*OK*	*OK*	*OK*	*OK*	*OK*	*OK*	*OK*	*OK*	*OK*	*OK*

Table 9: Duolingo’s cash flow statement forecast (in $ thousand)

Cash Flow Statement	2019A	2020A	2021A	2022A	2023E	2024F	2025F	2026F	2027F	2028F	2029F	2030F	2031F	2032F
Cash flows from operating activities														
Net income (loss)	(12,583.9)	(15,776.0)	(60,135.0)	(59,574.0)	(21,772.7)	6,596.8	44,872.5	100,949.0	190,637.4	350,510.1	591,482.8	929,390.4	1,106,053.7	1,275,856.6
Adjustments to reconcile net loss to net cash provided by operating activities														
Depreciation and amortization	1,251.0	2,256.0	2,726.0	4,870.0	8,622.2	11,183.9	13,700.3	16,744.1	20,105.4	24,401.9	29,466.6	35,060.3	40,804.4	46,039.9
Stock-based compensation	3,725.0	17,031.0	40,804.0	73,820.0	93,035.6	99,691.3	111,305.3	119,375.7	131,419.9	137,501.5	137,504.7	130,922.5	102,453.8	71,694.7
Gain on sale of capitalized software		-	-	-	-	-	-	-	-	-	-	-	-	-
Changes in assets and liabilities														
Deferred revenue		28,485.0	43,475.0	59,283.0	44,440.5	51,875.5	90,787.9	100,152.1	143,705.4	198,434.1	260,724.6	333,147.5	127,408.0	128,414.1
Accounts receivable		(10,445.0)	(12,713.0)	(13,565.0)	(47,184.0)	(22,541.7)	(37,602.6)	(42,424.6)	(70,076.2)	(89,877.7)	(115,638.6)	(147,917.4)	(57,206.5)	(57,658.3)
Deferred cost of revenues		(6,653.0)	(10,634.0)	(10,822.0)	(14,290.3)	(11,487.3)	(21,133.5)	(22,862.5)	(35,989.8)	(47,476.4)	(61,363.7)	(79,037.1)	(30,327.4)	(30,566.9)
Prepaid expenses and other current assets		(1,712.0)	(4,048.0)	(1,415.0)	(6,700.9)	(2,814.0)	(5,666.9)	(4,755.5)	(11,217.3)	(12,943.9)	(16,239.0)	(21,087.4)	(7,773.7)	(8,928.1)
Accounts payable		(1,615.0)	5,622.0	(6,655.0)	10,593.5	(1,197.1)	4,002.4	953.9	9,047.1	7,572.3	7,383.3	11,475.0	3,410.8	4,633.3
Accrued expenses and other current liabilities		6,213.0	3,708.0	8,720.0	3,467.4	9,618.5	11,100.9	13,666.0	18,530.4	26,419.1	36,185.1	43,864.9	17,053.6	17,188.2
Noncurrent assets and liabilities	411.0	(76.0)	365.0	(1,006.0)	-	-	-	-	-	-	-	-	-	-
Change in income tax payable	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Change in other assets	-	-	-	-	(940.4)	(150.2)	(927.1)	(1,148.0)	(1,660.7)	(2,135.5)	(2,528.9)	(3,568.8)	(1,416.8)	(1,354.0)
Net cash flow from leases		-	-	-	(13.0)	324.2	768.2	420.4	692.4	1,203.2	1,562.4	1,725.3	(1,843.1)	1,505.6
Net cash provided by operating activities	**2,152.0**	**17,708.0**	**9,170.0**	**53,656.0**	**68,822.0**	**141,099.9**	**211,207.4**	**281,070.6**	**395,194.1**	**593,609.0**	**868,539.4**	**1,233,975.2**	**1,298,616.6**	**1,446,825.1**
Cash flows from investing activities														
Capitalized software expense and purchases of intangible assets		(638.0)	(2,620.0)	(4,562.0)	(6,341.6)	(7,256.5)	(8,696.2)	(10,072.5)	(12,065.7)	(14,117.2)	(16,043.8)	(17,558.9)	(19,179.0)	(20,812.0)
Purchase of property and equipment		(3,376.0)	(3,586.0)	(5,562.0)	(7,927.0)	(9,235.5)	(11,305.1)	(13,430.0)	(16,590.3)	(20,167.4)	(24,065.8)	(28,094.2)	(30,686.4)	(33,299.1)
Proceeds from sale of capitalized software		-	-	-	-	-	-	-	-	-	-	-	-	-
Acquisition, net of $0 cash acquired		-	-	(4,050.0)	-	-	-	-	-	-	-	-	-	-
Net cash used for investing activities	**2,431.0**	**(4,014.0)**	**(6,206.0)**	**(14,174.0)**	**(14,268.5)**	**(16,492.0)**	**(20,001.3)**	**(23,502.5)**	**(28,655.9)**	**(34,284.6)**	**(40,109.6)**	**(45,653.0)**	**(49,865.4)**	**(54,111.1)**
Cash flows from financing activities														
Issuance of common stock in connection with the initial public offering, net of underwriting discounts and issuance costs		-	426,191.0	-	-	-	-	-	-	-	-	-	-	-
Net proceeds from issuance of convertible preferred stock		44,923.0	-	-	-	-	-	-	-	-	-	-	-	-
Proceeds from exercise of stock options		2,030.0	12,480.0	14,776.0	-	-	-	-	-	-	-	-	-	-
Repurchases of stock options		-	(7,335.0)	-	-	-	-	-	-	-	-	-	-	-
Repurchase of common stock		-	(868.0)	-	-	-	-	-	-	-	-	-	-	-
Change in long-term financial debt		-	-	-	-	-	-	-	-	-	-	-	-	-
Net cash provided by financing activities	**30,970.0**	**46,953.0**	**430,468.0**	**14,776.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Net increase in cash and cash equivalents	**35,553.0**	**60,647.0**	**433,432.0**	**54,258.0**	**54,553.4**	**124,607.9**	**191,206.1**	**257,568.0**	**366,538.2**	**559,324.4**	**828,429.8**	**1,188,322.2**	**1,248,751.2**	**1,392,714.0**
Cash and cash equivalents - Beginning of period		59,843.0	120,490.0	553,922.0	608,180.0	662,733.4	787,341.4	978,547.4	1,236,115.4	1,602,653.6	2,161,978.0	2,990,407.8	4,178,729.9	5,427,481.1
Cash and cash equivalents - End of period	**59,843.0**	**120,490.0**	**553,922.0**	**608,180.0**	**662,733.4**	**787,341.4**	**978,547.4**	**1,236,115.4**	**1,602,653.6**	**2,161,978.0**	**2,990,407.8**	**4,178,729.9**	**5,427,481.1**	**6,820,195.1**

Table 10: DCF valuation of Duolingo (in $ thousand) (created by the author)

Valuation	2019A	2020A	2021A	2022A	2023E	2024F	2025F	2026F	2027F	2028F	2029F	2030F	2031F	2032F
Time Factor						1	2	3	4	5	6	7	8	9
FCFF						**24,742.6**	**80,059.6**	**138,919.9**	**236,086.5**	**422,755.1**	**691,891.5**	**1,059,243.1**	**1,149,557.2**	**1,320,867.7**
Discount rate (WACC)						0.905	0.819	0.741	0.671	0.607	0.550	0.497	0.450	0.407
PV of FCFF						22,393.0	65,576.1	102,982.3	158,392.8	256,696.0	380,219.4	526,814.9	517,438.8	538,088.6
Sum of PVs						2,568,601.9								
Terminal Value														16,713,249.6
PV of Terminal Value														**6,808,561.6**
Enterprise Value						9,377,163.5								

Equity Bridge	
Enterprise Value	9,377,163.5
(-) Financial Debt	-
(-) Debt-like items:	-
(+) Cash & cash equivalents	662,733.4
(+) Cash-like items	-
Equity Value	10,039,896.9
Price per Share	239.0

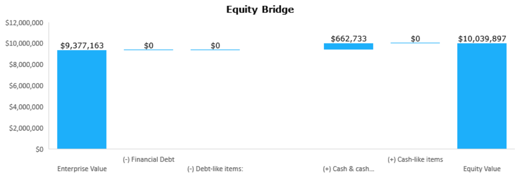

Table 11: Valuation of Duolingo using the EVA method (in $ thousand) (created by the author)

Valuation	2019A	2020A	2021A	2022A	2023E	2024E	2025E	2026E	2027E	2028E	2029E	2030E	2031E	2032E
Time Factor						1	2	3	4	5	6	7	8	9
NOPAT						**6,596.8**	**44,872.5**	**100,949.0**	**190,637.4**	**350,510.1**	**591,482.8**	**929,390.4**	**1,106,053.7**	**1,275,856.6**
Discount rate (levered Cost of Equity)						0.905	0.819	0.741	0.671	0.607	0.550	0.497	0.450	0.407
Invested Capital						8,326.2	20,782.6	38,372.0	53,548.9	72,607.2	109,600.2	161,472.8	198,630.7	214,351.2
Return on Invested Capital						79.2%	215.9%	263.1%	356.0%	482.7%	539.7%	575.6%	556.8%	595.2%
Annual Economic Profit (in %)						68.7%	205.4%	252.6%	345.5%	472.3%	529.2%	565.1%	546.3%	584.7%
Annual Economic Profit (in $k)						5,723.1	42,691.8	96,922.7	185,018.6	342,891.6	579,982.7	912,447.4	1,085,211.8	1,253,365.1
PV of Economic Value Added						**5,179.7**	**34,968.5**	**71,849.5**	**124,130.8**	**208,203.1**	**318,721.5**	**453,806.0**	**488,475.7**	**510,589.7**
Terminal Value														15,859,124.0
PV of Terminal Value														**6,460,612.1**
Economic Value Added						**8,676,536.5**								
Net Debt						662,733.4								
Equity Value						9,339,269.9								
Price per Share						233.1								

Table 12: Sensitivity tables – DCF (created by the author)

		Cost of Capital										
		9.49%	9.69%	9.89%	10.09%	10.29%	10.49%	10.69%	10.89%	11.09%	11.29%	11.49%
	1.40%	254.9	247.2	239.8	232.8	226.1	219.7	213.7	207.9	202.3	197.0	192.0
	1.60%	259.7	251.6	244.0	236.7	229.8	223.2	217.0	211.0	205.3	199.8	194.6
	1.80%	264.7	256.3	248.4	240.9	233.7	226.9	220.4	214.2	208.3	202.7	197.3
	2.00%	270.0	261.3	253.0	245.2	237.8	230.7	224.0	217.6	211.6	205.8	200.2
Perpetual Growth Rate	2.20%	275.6	266.5	257.9	249.8	242.1	234.7	227.8	221.2	214.9	208.9	203.2
	2.40%	281.5	272.0	263.0	254.6	246.6	239.0	231.8	224.9	218.4	212.2	206.3
	2.60%	287.7	277.8	268.4	259.6	251.3	243.4	235.9	228.8	222.1	215.7	209.6
	2.80%	294.3	283.9	274.2	265.0	256.3	248.1	240.3	232.9	225.9	219.3	213.0
	3.00%	301.3	290.4	280.2	270.6	261.5	253.0	244.9	237.2	230.0	223.1	216.5
	3.20%	308.7	297.3	286.6	276.5	267.1	258.1	249.7	241.8	234.2	227.1	220.3
	3.40%	316.7	304.7	293.4	282.9	272.9	263.6	254.8	246.5	238.7	231.2	224.2

		TV COR margin						
		(3.0%)	(2.0%)	(1.0%)	-	1.0%	2.0%	3.0%
	(3.0%)	186.7	191.1	195.4	199.8	204.1	208.5	212.8
	(2.0%)	199.8	204.1	208.5	212.8	217.2	221.6	225.9
TV Opex margin	(1.0%)	212.8	217.2	221.6	225.9	230.3	234.6	239.0
	-	225.9	230.3	234.6	239.0	243.3	247.7	252.0
	1.0%	239.0	243.3	247.7	252.0	256.4	260.7	265.1
	2.0%	252.0	256.4	260.7	265.1	269.4	273.8	278.1
	3.0%	265.1	269.4	273.8	278.1	282.5	286.9	291.2

		TV Paid Subscriber g						
		(3.0%)	(2.0%)	(1.0%)	-	1.0%	2.0%	3.0%
	(3.0%)	224.5	226.8	229.0	231.3	233.6	235.8	238.1
	(2.0%)	227.0	229.3	231.6	233.9	236.1	238.4	240.7
TV ASRPU g	(1.0%)	229.5	231.8	234.1	236.4	238.7	241.0	243.3
	-	232.0	234.3	236.6	239.0	241.3	243.6	245.9
	1.0%	234.5	236.8	239.2	241.5	243.9	246.2	248.6
	2.0%	237.0	239.3	241.7	244.1	246.4	248.8	251.2
	3.0%	239.5	241.8	244.2	246.6	249.0	251.4	253.8

		TV Ad Revenue per DAU g						
		(3.0%)	(2.0%)	(1.0%)	-	1.0%	2.0%	3.0%
	(3.0%)	236.5	236.8	237.1	237.4	237.7	238.0	238.4
	(2.0%)	237.0	237.3	237.6	237.9	238.3	238.6	238.9
TV IAP per DAU g	(1.0%)	237.5	237.8	238.2	238.5	238.8	239.1	239.4
	-	238.1	238.4	238.7	239.0	239.3	239.6	239.9
	1.0%	238.6	238.9	239.2	239.5	239.8	240.1	240.4
	2.0%	239.1	239.4	239.7	240.0	240.3	240.6	240.9
	3.0%	239.6	239.9	240.2	240.5	240.8	241.1	241.4

		TV DET price change						
		(3.0%)	(2.0%)	(1.0%)	-	1.0%	2.0%	3.0%
	(3.0%)	238.0	238.2	238.3	238.5	238.6	238.8	238.9
	(2.0%)	238.2	238.3	238.5	238.7	238.8	239.0	239.1
TV test taker g	(1.0%)	238.3	238.5	238.7	238.8	239.0	239.1	239.3
	-	238.5	238.7	238.8	239.0	239.1	239.3	239.4
	1.0%	238.7	238.8	239.0	239.1	239.3	239.4	239.6
	2.0%	238.8	239.0	239.1	239.3	239.4	239.6	239.8
	3.0%	239.0	239.1	239.3	239.4	239.6	239.8	239.9

Table 13: Sensitivity tables – EVA (created by the author)

		Cost of Capital										
		9.49%	9.69%	9.89%	10.09%	10.29%	10.49%	10.69%	10.89%	11.09%	11.29%	11.49%
Perpetual Growth Rate	1.40%	249.1	241.4	234.0	227.0	220.3	213.9	207.9	202.1	196.5	191.3	186.2
	1.60%	253.9	245.8	238.1	230.9	224.0	217.4	211.1	205.2	199.5	194.0	188.8
	1.80%	258.9	250.5	242.5	235.0	227.8	221.0	214.6	208.4	202.5	196.9	191.6
	2.00%	264.1	255.4	247.1	239.3	231.9	224.9	218.2	211.8	205.7	199.9	194.4
	2.20%	269.7	260.6	252.0	243.9	236.2	228.9	221.9	215.3	209.0	203.1	197.4
	2.40%	275.5	266.1	257.1	248.6	240.6	233.1	225.9	219.0	212.5	206.3	200.5
	2.60%	281.7	271.8	262.5	253.7	245.3	237.5	230.0	222.9	216.2	209.8	203.7
	2.80%	288.3	277.9	268.2	259.0	250.3	242.1	234.3	227.0	220.0	213.4	207.1
	3.00%	295.3	284.4	274.2	264.6	255.5	247.0	238.9	231.3	224.0	217.1	210.6
	3.20%	302.7	291.3	280.6	270.5	261.1	252.1	243.7	235.8	228.2	221.1	214.3
	3.40%	310.6	298.6	287.4	276.8	266.9	257.6	248.8	240.5	232.7	225.3	218.2

		TV COR margin						
	233.1	(3.0%)	(2.0%)	(1.0%)	-	1.0%	2.0%	3.0%
TV Opex margin	(3.0%)	178.3	182.8	187.4	192.0	196.5	201.1	205.7
	(2.0%)	192.0	196.5	201.1	205.7	210.2	214.8	219.4
	(1.0%)	205.7	210.2	214.8	219.4	223.9	228.5	233.1
	-	219.4	223.9	228.5	233.1	237.6	242.2	246.7
	1.0%	233.1	237.6	242.2	246.7	251.3	255.9	260.4
	2.0%	246.7	251.3	255.9	260.4	265.0	269.6	274.1
	3.0%	260.4	265.0	269.6	274.1	278.7	283.3	287.8

		TV Paid Subscriber g						
	233.1	(3.0%)	(2.0%)	(1.0%)	-	1.0%	2.0%	3.0%
TV ASRPU g	(3.0%)	226.0	227.1	228.2	229.3	230.4	231.5	232.6
	(2.0%)	227.2	228.4	229.5	230.6	231.7	232.8	233.9
	(1.0%)	228.5	229.6	230.7	231.8	232.9	234.0	235.2
	-	229.7	230.8	231.9	233.1	234.2	235.3	236.4
	1.0%	230.9	232.0	233.2	234.3	235.4	236.6	237.7
	2.0%	232.1	233.2	234.4	235.5	236.7	237.8	239.0
	3.0%	233.3	234.5	235.6	236.8	237.9	239.1	240.3

		TV Ad Revenue per DAU g						
		(3.0%)	(2.0%)	(1.0%)	-	1.0%	2.0%	3.0%
TV IAP per DAU g	(3.0%)	231.9	232.0	232.2	232.3	232.5	232.6	232.8
	(2.0%)	232.1	232.3	232.4	232.6	232.7	232.9	233.0
	(1.0%)	232.4	232.5	232.7	232.8	233.0	233.1	233.2
	-	232.6	232.8	232.9	233.1	233.2	233.3	233.5
	1.0%	232.9	233.0	233.2	233.3	233.4	233.6	233.7
	2.0%	233.1	233.3	233.4	233.5	233.7	233.8	234.0
	3.0%	233.4	233.5	233.6	233.8	233.9	234.1	234.2

		TV DET price change						
		(3.0%)	(2.0%)	(1.0%)	-	1.0%	2.0%	3.0%
TV test taker g	(3.0%)	232.6	232.7	232.7	232.8	232.9	233.0	233.0
	(2.0%)	232.7	232.7	232.8	232.9	233.0	233.0	233.1
	(1.0%)	232.7	232.8	232.9	233.0	233.0	233.1	233.2
	-	232.8	232.9	233.0	233.1	233.1	233.2	233.3
	1.0%	232.9	233.0	233.1	233.1	233.2	233.3	233.4
	2.0%	233.0	233.0	233.1	233.2	233.3	233.4	233.4
	3.0%	233.0	233.1	233.2	233.3	233.4	233.4	233.5

Table 14: Initial peer group overview (created by the author)

	Non-SS edtech peers	*SS edtech peers*	*Mobile gaming & entertainment software peers*	*AI peers*	*Large cap tech peers*
Peer 1	Coursera	PowerSchool Holdings	Electronic Arts	HubSpot	Meta
Peer 2	Udemy	Instructure	Take Two Interactive	Shopify	Alphabet
Peer 3	Chegg	Kahoot	Tencent	Braze	Adobe
Peer 4	Stride		Nexon Corp.		Microsoft
Peer 5	Grand Canyon Education		Roblox Corp.		
Peer 6	2U				
Peer 7	Bright Horizons Family Solutions				

Table 15: Duolingo's final peer group (in $ thousand) (created by the author)

		Capitalization							Revenue			Revenue		
Company Name	**Share Price**	**Diluted Shares**	**Equity Value**	**Cash**	**Total Debt**	**Preferred**	**Other**	**Enterprise Value**	**LTM (EoQ3)**	**FY 23**	**FY 24**	**LTM (EoQ3)**	**FY 23**	**FY 24**
PowerSchool Holdings	23.6	201,940.6	4,763,778.8	(28,400.0)	753,600.0	456,700.0	-	5,945,678.8	656,900.0	691,600.0	766,400.0	656,900.0	691,600.0	766,400.0
Instructure	26.2	143,990.7	3,765,356.8	(304,900.0)	505,800.0	-	-	3,966,256.8	519,600.0	529,200.0	580,100.0	519,600.0	529,200.0	580,100.0
Kahoot	3.1	492,836.1	1,547,505.4	(96,600.0)	7,400.0	-	-	1,458,305.4	157,700.0	169,500.0	195,500.0	157,700.0	169,500.0	195,500.0
Braze	54.9	98,866.9	5,431,745.8	(472,200.0)	51,600.0	-	-	5,011,145.8	408,700.0	454,100.0	555,800.0	408,700.0	454,100.0	555,800.0
Roblox Corporation	38.7	623,737.0	24,126,147.2	(2,156,300.0)	1,634,400.0	(5,900.0)	-	23,598,347.2	2,628,300.0	3,438,000.0	3,879,400.0	2,628,300.0	3,438,000.0	3,879,400.0
HubSpot	496.5	50,330.5	24,990,121.2	(1,597,100.0)	787,100.0	-	-	24,180,121.2	2,058,000.0	2,145,600.0	2,529,400.0	2,058,000.0	2,145,600.0	2,529,400.0
Shopify	73.9	1,205,846.1	89,063,790.7	(4,918,000.0)	1,122,000.0	-	-	85,267,790.7	6,651,000.0	6,988,500.0	8,341,300.0	6,651,000.0	6,988,500.0	8,341,300.0
Adobe	611.0	455,300.0	278,192,853.0	(7,516,000.0)	4,096,000.0	-	-	274,772,853.0	18,886,000.0	19,377,700.0	21,778,500.0	18,886,000.0	19,377,700.0	21,778,500.0
Microsoft	374.5	7,432,262.3	2,783,456,564.8	(143,951,000.0)	105,681,000.0	-	-	2,745,186,564.8	218,310,000.0	243,253,400.0	276,663,300.0	218,310,000.0	243,253,400.0	276,663,300.0
Maximum	611.0		2,783,456,564.8					2,745,186,564.8	218,310,000.0	243,253,400.0	276,663,300.0	218,310,000.0	243,253,400.0	276,663,300.0
75th percentile	374.5		89,063,790.7					85,267,790.7	6,651,000.0	6,988,500.0	8,341,300.0	6,651,000.0	6,988,500.0	8,341,300.0
Median	**54.9**		**24,126,147.2**					**23,598,347.2**	**2,058,000.0**	**2,145,600.0**	**2,529,400.0**	**2,058,000.0**	**2,145,600.0**	**2,529,400.0**
Average	**189.2**		**357,259,762.6**					**352,154,118.2**	**27,808,466.7**	**30,783,066.7**	**35,032,188.9**	**27,808,466.7**	**30,783,066.7**	**35,032,188.9**
25th percentile	26.2		4,763,778.8					5,011,145.8	519,600.0	529,200.0	580,100.0	519,600.0	529,200.0	580,100.0
Minimum	3.1		1,547,505.4					1,458,305.4	157,700.0	169,500.0	195,500.0	157,700.0	169,500.0	195,500.0
PowerSchool Holdings									9.05x	8.60x	7.76x	7.25x	6.89x	6.22x
Instructure									7.63x	7.49x	6.84x	7.25x	7.12x	6.49x
Kahoot									9.25x	8.60x	7.46x	9.81x	9.13x	7.92x
Braze									12.26x	11.04x	9.02x	13.29x	11.96x	9.77x
Roblox Corporation									8.98x	6.86x	6.08x	9.18x	7.02x	6.22x
HubSpot									11.75x	11.27x	9.56x	12.14x	11.65x	9.88x
Shopify									12.82x	12.20x	10.22x	13.39x	12.74x	10.68x
Adobe									14.55x	14.18x	12.62x	14.73x	14.36x	12.77x
Microsoft									12.57x	11.29x	9.92x	12.75x	11.44x	10.06x
Maximum									14.55x	14.18x	12.62x	14.73x	14.36x	12.77x
75th percentile									12.57x	11.29x	9.92x	13.29x	11.96x	10.06x
Median									**11.75x**	**11.04x**	**9.02x**	**12.14x**	**11.44x**	**9.77x**
Average									**10.98x**	**10.17x**	**8.83x**	**11.09x**	**10.26x**	**8.89x**
25th percentile									9.05x	8.60x	7.46x	9.18x	7.12x	6.49x
Minimum									7.63x	6.86x	6.08x	7.25x	6.89x	6.22x

Table 16: Comparable transactions overview (created by the author)

Company	**Transaction Type**	**Industry**	**Deal date**	**Source**	**EV / Revenue**	**EV / EBITDA**
Coursera	IPO	Educational Softwa	3/31/2021	Pitch Book Data	13.11x	
17zuoye	IPO	Educational Softwa	12/4/2020	Pitch Book Data	13.83x	
Instructure	IPO	Educational Softwa	7/22/2021	Pitch Book Data	6.83x	42.19x
Itcast	IPO	Educational and Tra	1/12/2021	Pitch Book Data		62.81x
eEducation Albert	IPO	Educational Softwa	10/1/2021	Pitch Book Data	13.69x	
Visionary Education Technology Holdings Group	IPO	Educational and Tra	5/17/2022	Pitch Book Data	29.91x	94.73x
Bilibili Inc.	M&A	Entertainment Softw	10/3/2018	Bloomberg	9.07x	
Glu Mobile Inc.	M&A	Entertainment Softw	4/29/2015	Bloomberg		62.28x
Bragg Gaming Group	M&A	Entertainment Softw	1/23/2018	Bloomberg	17.59x	
Kahoot	M&A	Educational Softwa	7/14/2023	Bloomberg	11.27x	172.00x
PluralSight	M&A	Educational Softwa	12/12/2020	Bloomberg	7.62x	
Maximum					29.91x	172.00x
75th percentile					14.77x	94.73x
Median					**13.40x**	**62.81x**
Average					**14.41x**	**86.80x**
25th percentile					10.72x	62.28x
Minimum					6.83x	42.19x